FHWA-MA-EIS-82-02-DS2

CENTRAL ARTERY (I-93)/
THIRD HARBOR TUNNEL (I-90) PROJECT

DRAFT

SUPPLEMENTAL

ENVIRONMENTAL IMPACT STATEMENT/REPORT AND SUPPLEMENTAL FINAL SECTION 4(f) EVALUATION

Central Artery—Boston, Massachusetts

PART I – Vol. 1 of 2
• Chapters 1–9

Federal Highway Administration
Massachusetts Department of Public Works

FHWA-MA-EIS-82-02-DS2

CENTRAL ARTERY (INTERSTATE 93)/ THIRD HARBOR TUNNEL (INTERSTATE 90) PROJECT BOSTON, MASSACHUSETTS

SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT/REPORT

Submitted Pursuant to 42 U.S.C. 4332(2) (C)
(and where applicable, 49 U.S.C. 303)
by the
U.S. Department of Transportation, Federal Highway Administration
and
Massachusetts Department of Public Works

Cooperating Agencies

U.S. Advisory Council on Historic Preservation
U.S. Army Corps of Engineers
U.S. Coast Guard
U.S. Department of the Interior
- Fish and Wildlife Service
- National Park Service
- Geological Survey

U.S. Environmental Protection Agency
Federal Aviation Administration
National Marine Fisheries
Massachusetts Bay Transportation Authority
Massachusetts Port Authority
Massachusetts Turnpike Authority
Massachusetts Water Resources Authority
Massachusetts Aeronautics Commission
Massachusetts Historical Commission
Massachusetts Executive Office of Environmental Affairs
- Department of Environmental Management
- Department of Environmental Protection
- Metropolitan District Commission
- Department of Marine Fisheries
- Coastal Zone Management
- Massachusetts Environmental Policy Act and Review

Metropolitan Area Planning Council
City of Boston
Boston Water and Sewer Commission
Boston Conservation Commission
City of Cambridge
Cambridge Conservation Commission

5/2/90
Date of Approval

William V. Twomey
For MDPW

May 7, 1990
Date of Approval

Anthony J. Fusco
For FHWA

This is a Supplement to FHWA-MA-EIS-02-F and EOEA No. 4325. This Supplement describes the design modifications to the Preferred Alternative in the approved FEIS/R and its impacts for the Central Artery/Third Harbor Tunnel Project.

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PART I – Vol. 1 of 2

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Federal Highway Administration
Massachusetts Department of Public Works

Summary

SUMMARY

S.1 DESCRIPTION OF THE PROPOSED ACTION

The Commonwealth of Massachusetts Department of Public Works (the Department) and the United States Federal Highway Administration (FHWA) have issued this Supplemental Environmental Impact Statement/Report (SEIS/R) for the proposed Central Artery (I-93)/Third Harbor Tunnel (I-90) Project (referred to as the Proposed Action, the Artery/Tunnel Project, or the project). The project is located in the City of Boston, which is in Suffolk County, Massachusetts. This SEIS/R supplements the Final Environmental Impact Statement/ Report (FEIS/R) for the project approved in 1985.

The SEIS/R is presented in three parts. Part I describes the Proposed Action and its long-term and construction period impacts. Part II describes the alternatives analyses conducted for three major design refinements and for the materials disposal program, and summarizes alternatives analyses of other project changes. Part II also identifies design modifications to the Proposed Action which are currently under consideration. Part III includes the Section 4(f) Evaluation which describes project impacts on parklands and historic and archaeological resources. In addition, the SEIS/R is supported by several technical appendices.

The SEIS/R describes design developments in the approved project and its impacts in response to the 14 outstanding issues identified in the FEIS/R and public comments received on the FEIS/R. The Proposed Action and mitigation features are described in more detail than in the FEIS/R. Moreover, the environmental benefits of the project have been increased and adverse impacts reduced or eliminated.

The Proposed Action, consisting of approximately 7 miles of new and reconstructed roadways, includes the following major elements which are shown in Figure S.1:

- o Construction of a widened, mostly underground Interstate 93 (I-93) from just north of its interchange with Route 1 in Charlestown to just south of the Massachusetts Avenue interchange. I-93 is referred to as the Central Artery north of Kneeland Street, and as the Southeast Expressway south of Kneeland Street.
- o Construction of an extension of I-90 via a Seaport Access Road and Third Harbor Tunnel to Logan Airport in East Boston, with a connection to Route 1A. The I-90 extension will begin at the present terminus of the Massachusetts Turnpike (I-90) at the Southeast Expressway and proceed eastward, mainly in tunnel, through South Boston, under Boston Harbor, and into Logan Airport. In addition, a much improved and expanded high-occupancy vehicle (HOV) system will be incorporated along I-93 and I-90 to link downtown Boston at Kneeland Street and the proposed South Station Transportation Center with Logan Airport and points south and west of Boston.
- o Construction of an extended frontage road system parallel to I-93 both northbound and southbound from Causeway Street to just past Southampton Street. In addition, a frontage road system parallel to I-90 eastbound and westbound will be constructed from the Albany Street Extension to the Frontage Road northbound via Marginal Road and West Broadway and Herald Street.
- o Construction of a South Boston Bypass Road, most of which will be in an existing railroad right-of-way. It will connect the Southeast Expressway (I-93) directly to the Seaport Access Road (I-90) and a relocated Massport Haul Road in South Boston.

S.1.1 Purpose Of Action

The FEIS/R documented the need to improve both the capacity and safety of existing highway facilities, based on traffic levels in 1982 and projected levels for the year 2010. Since the preparation of the FEIS/R, the need for improvements has intensified as the metropolitan area has undergone unforeseen growth in new office space, employment and vehicle ownership and use. The consequent increase in traffic already exceeded by 1987 the levels previously forecast for the year 2010.

Current forecasts indicate that future traffic levels will overwhelm existing facilities, resulting in widespread congestion for up to 14 hours a day at key locations and curtailing economic growth.

One of the major purposes of the project is to increase traffic capacity by widening the Central Artery (I-93) to eight traffic lanes with additional operational lanes. The roadway geometry and weaving movements will be revised and acceleration and deceleration lanes will be added to reduce congestion and improve traffic flow. As a result, system safety also will be improved and traffic on local streets will be reduced. The accident rate on the Central Artery is nearly twice the nationwide average for the interstate system.

Another major purpose is to complete I-90, to double cross-harbor capacity and to improve access to Logan Airport. Air passenger volume grew from 12.1 million in 1977 to 23.3 million in 1987; it is expected to reach 37.5 million in 2020. In addition, air freight, with its many time-sensitive shipments, has increased substantially and has become increasingly important to the regional economy. With traffic in the Sumner Tunnel already operating at or near capacity for 9 or more hours each day, the ability of the system to deliver air passengers and air freight in a timely manner is jeopardized.

Connecting I-90 to Logan Airport via the Seaport Access Road (six through lanes) and the Third Harbor Tunnel (four through lanes) will divert traffic away from the Central Artery by providing travellers from the west and south of Boston with a more direct connection to Logan Airport. Currently, airport and Route 1A bound traffic must pass through downtown Boston to reach the Sumner and Callahan Tunnels for access to Logan Airport, East Boston, and points north.

The purpose of other major elements of the Proposed Action is to improve the existing transportation system in several ways:

- o The Seaport Access Road also will increase accessibility to the South Boston seaport and industrial areas.
- o The improved HOV system will offer vehicles carrying multiple passengers head-of-queue privileges throughout most of the project.
- o The extended frontage roads system will provide increased accessibility to local streets along the Central Artery and Southeast Expressway.
- o Construction of the South Boston Bypass Road will create a new route for commercial vehicles, such as trucks, buses and public safety vehicles, that avoids local streets.

S.1.2 Context Of The SEIS/R

The SEIS/R is prepared pursuant to FHWA guidance for a *Supplemental* Environmental Impact Statement. The document also is intended to meet the requirements of the Massachusetts Environmental Policy Act.

The approved FEIS/R discussed in detail 14 alternatives and concepts, including a no-build option, that were considered in the environmental process before selection of a Preferred Alternative. Also, 11 transit options were discussed and evaluated, with the conclusion that future traffic demand could not be adequately satisfied by transit improvements alone. It was recognized, however, that transit improvements could supplement the service provided by the proposed highway improvements, and provisions for improved bus service across the Harbor were included in the alternative selected by the Commonwealth. The Massachusetts Bay Transportation Authority (MBTA) has proceeded with major improvements in the transit system serving the study area as part of its overall regional transportation plan.

In keeping with the usual practice for major highway projects, revisions and refinements will continue to be made as the project moves through the preliminary engineering, final design, and construction phases. The design is currently at an adequate level of detail, as presented in this SEIS/R, to assess environmental impacts. The public and agency meetings and interaction described in the SEIS/R will continue throughout the SEIS/R review process, the final design phase, and the construction phase of the Artery/Tunnel Project. Agency and general public concerns and feedback are important factors in the implementation of specific mitigation measures or necessary

FIGURE S.1

Proposed Action - Central Artery/Tunnel Project

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

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adjustments as the project proceeds.

S.2 MAJOR ACTIONS PROPOSED BY OTHER GOVERNMENTAL AGENCIES

Other major actions proposed by public agencies in the project area include the following:

- o U.S. Department of Housing and Urban Development (HUD) assisted urban renewal projects, including proposed site improvements, roadways, and utilities in the North Station area.

- o U.S. Urban Mass Transportation Administration (UMTA)/Massachusetts Bay Transportation Authority (MBTA) transit improvements, including: Orange and Green Lines and commuter rail at North Station; Blue Line at Airport and Aquarium stations; South Station Transportation Center; the Wye Connector; and Dorchester Line bridge at Southampton Street.

- o FHWA/Department/City of Boston Transportation Systems Management improvements in the Dewey Square area.

- o FHWA/Department/City of Boston computerized traffic signal system.

- o Several related combined sewer overflow treatment, collection, and outfall facility projects by the U.S. Environmental Protection Agency (EPA)/Metropolitan District Commission (MDC)/Boston Water and Sewer Commission (BWSC) in the South Bay, Fort Point Channel, Bird Island Flats and waterfront areas; and the Deer Island secondary treatment plant and effluent outfall tunnel by the Massachusetts Water Resources Authority (MWRA). Some of these projects are under construction.

- o National Park Service rehabilitation of the Old State House and Faneuil Hall.

- o U.S. Coast Guard Special Anchorage Area at the mouth of Fort Point Channel.

- o U.S. Army Corps of Engineers maintenance dredging.

- o Federal Aviation Administration (FAA)/ Massachusetts Port Authority (Massport) airport-related improvements to Bird Island Flats at Logan Airport, including airfield facilities, cargo facilities, and surface access.

Other major non-Federal agency projects in the area include the East Boston piers development being planned by the Boston Redevelopment Authority (BRA) and Massport; planned improvements to pedestrian access by the MDC to the Lower Charles River area (Esplanade Extension), and the possible transit improvements in the South Boston Piers/ Fort Point Channel area by the MBTA.

S.3 PROJECT CHANGES AND REFINEMENTS

Since 1985, the design of the Preferred Alternative has been developed to improve traffic operations, to mitigate potential impacts further, and to address issues identified for further design study in the FEIS/R. The SEIS/R describes the alternative design changes considered subsequently in developing the Proposed Action; Part II of the SEIS/R contains a detailed analysis of the three major changes -- Area North of Causeway Street (crossings of the Charles River), South Boston Bypass Road, and toll plaza relocation -- along with a comprehensive evaluation of alternatives considered for materials disposal. Part II also includes a description of other alignment refinements in a matrix format.

Following are brief descriptions of design changes for some parts of the project, as they differ from those described in the FEIS/R. These changes are described in the order of the six geographical subareas defined by the SEIS/R, from north to south and west to east (see Figure S.2). The last two changes described are located in more than one subarea. The changes are followed by a description of the materials disposal program, developed since the FEIS/R.

Area North Of Causeway Street.
The Leverett Circle Connector Has Been Revised: In the Proposed Action design, the connector from both southbound and northbound I-93 to Leverett Circle will start on the north side of the Charles River and run south over the river on a double-deck elevated structure, parallel to and immediately west of the proposed I-93 northbound

and southbound Charles River bridges.

This change from the FEIS/R improves the constructibility and the design of the connector. For example, the tunnels in the Charles River in the FEIS/R design would require considerable filling along the south bank; the Proposed Action design eliminates the need for that filling. The current design also improves traffic operations by lengthening weaving distances.

The highway and ramp changes in the Area North of Causeway Street will not disrupt the major pedestrian crossings near Causeway Street, and will avoid the historic resources.

Alternatives Considered: The Charles River crossing is one of the three major design changes since the FEIS/R. Please see Chapter B 1 of Part II of the SEIS/R for a complete alternatives analysis discussion. Also see Part III of the SEIS/R which includes the Section 4(f) Evaluation. A total of 31 alternatives for connections between the Central Artery and Leverett Circle/ Storrow Drive were considered for overall viability. In all of the options, I-93 is carried on new bridges across the Charles River and the Central Artery North Area project (CANA) ramps provide connections between I-93 and Route 1. In addition to the FEIS/R design (5A Modified), three "families" of design concepts were carried forward and examined in greater depth: viaduct/tunnel concept (S Modified), Charles River tunnel concept (T Modified), and the viaduct concept (Z Modified, the Proposed Action). The other 28 schemes were dropped from further study due to severe geometric, operational, or constructibility problems or because they were superseded by refinements in others.

Alternative S Modified (viaduct/tunnel concept) places the Leverett Circle connector to and from I-93 southbound in tunnel south of and inland from the Charles River, and the Leverett Circle connector to and from I-93 northbound on viaduct in the same corridor. Alternative T Modified (Charles River tunnel concept) uses the same southbound tunnel connection as S Modified, but makes the connections to the north in a tunnel under the Charles River. Alternative Z Modified (viaduct/concept), the Proposed Action, makes both the northbound and southbound connections on viaduct on the north side of the river. Additional ventilation buildings would be required with alternatives 5A Modified, S Modified, and T Modified, but none with the Proposed Action.

Those alternatives were examined as to their constructibility, effects on traffic and transportation, and environmental impacts. Z Modified, S Modified and T Modified all relocate the main river crossing west of the existing I-93 bridge and parallel to the main commuter rail link to North Station. This design concentrates transportation facilities in one corridor allowing the expansion of Paul Revere Landing Park, but affecting the Millers River as a result. Z Modified is the only alternative that would not introduce highway ramps into the pedestrian connection between Causeway Street and the Metropolitan District Commission (MDC) locks walkway at the new Charles River dam. On the north bank of the Charles River, none of the alternatives would conflict with pedestrian circulation to a significant degree on a permanent basis; the Z Modified alignment would cover a broader area than the other alternatives.

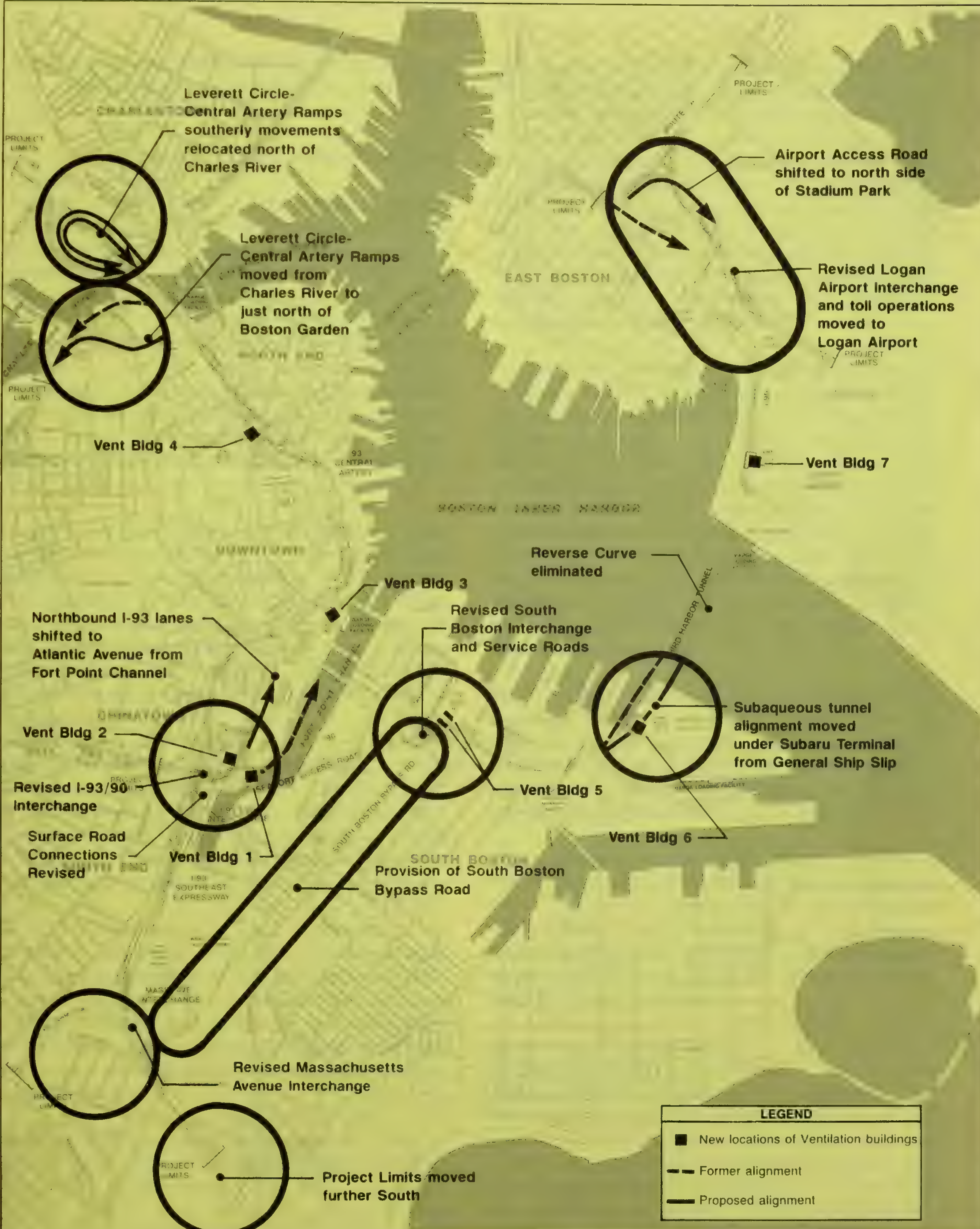
During the construction period, all of the alternatives would result in temporary disruptions of pedestrian circulation at various locations for short periods of time; the only alternative that would result in a major negative construction period impact is T Modified. Alternative Z Modified is the most constructible solution involving significantly less disruption to vehicular and commuter railroad traffic than other alternatives.

Z Modified provides the best overall solution to traffic operations in the majority of categories evaluated. Z Modified compares favorably with the other alternatives in most of the environmental categories; an examination of potential design options to reduce the number of piers in the river for the Charles River bridge crossing is currently underway.

Central Area.

Northbound I-93 Lanes: Northbound I-93 lanes have been shifted from Fort Point Channel to under Atlantic Avenue.

More detailed engineering studies have been conducted on deep tunneling methods, and it has been determined that construction of a tunnel beneath



FIGURE

S.2

Major Design Revisions Since 1985 FEIS/R

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

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the Red Line mezzanine at South Station is feasible. Consequently, construction in Fort Point Channel can be substantially reduced.

I-93/I-90 Interchange And Massachusetts Avenue Interchange Area.
Southern Project Limits: The southern project limits have been extended further south from north of the Massachusetts Avenue interchange to approximately 500 feet south of Southampton Street. This change was necessary because the number of proposed southbound lanes has been increased to six between West Fourth Street and the Castle Metal Company. In order for six lanes of traffic to merge into the existing Southeast Expressway's three fully operational lanes (plus one lane operational during peak traffic hours), an additional segment of the Southeast Expressway must be modified to allow for a safe merge.

Arterial Street/Frontage Road System: An arterial street and frontage road system has been added to the network parallel to I-93 and I-90. The proposed arterial street system will connect surface streets in the Central Area to those in the I-93/I-90 Interchange area. In addition, surface roads that currently parallel the I-90 Massachusetts Turnpike will be extended eastward to complete the network.

I-93/Massachusetts Avenue Interchange: This interchange has been improved. Traffic to and from I-93 south- and northbound will use the frontage road system to reach the Massachusetts Avenue connector. This system will eliminate the existing left-hand on- and off-ramps.

I-93/I-90 Interchange: This interchange also has been improved. Since the I-93 northbound alignment was shifted to the west under Atlantic Avenue, the connecting ramps to and from I-90 and surface streets also were moved and redesigned. As a result, the geometrics of these redesigned ramps and connections have been improved from the FEIS/R designs.

South Boston/South Boston Bypass Road Area.
Bypass Road: The South Boston Bypass Road has been added to the design.

Alternatives Considered: The South Boston Bypass Road is one of the three major changes since the FEIS/R. Please see Chapter 3 of Part IIB of the SEIS/R for a complete alternatives discussion. In addition to the Proposed Action, a "no-build" alternative of maintaining the South Boston Haul Road (to be built in advance of the project as a construction traffic mitigation measure) as a permanent roadway, but not connecting it to I-93 and I-90, was examined. Both alternatives were evaluated against objectives including improvements of service levels at the I-93/I-90 Interchange, provision of a hazardous cargo route, diversion of truck traffic from existing streets, and provision of an HOV route.

A permanent Haul Road would continue to provide an attractive limited-access truck route for passage through parts of South Boston, in lieu of the existing truck routes in South Boston. This would relieve local and arterial streets with residential and commercial uses along them of through truck traffic, and enable other traffic on existing streets to move more efficiently. On the other hand, it would not reduce the number of vehicles entering the I-93/I-90 Interchange to improve the level of service there and would not serve as an HOV route, the latter a major policy objective for the region.

The South Boston Bypass Road would be a connection between I-93 and I-90, would improve safety by removing trucks (including fuel trucks) from South Boston streets, and would provide a direct connection for those commercial vehicles desiring access to South Boston or Logan Airport.

There are only minimal differences in the predicted environmental impacts of the two alternatives. Due to the Bypass Road's contribution to the efficiency and effectiveness of the system under the Proposed Action, higher traffic volumes would result in some air quality and noise differences at various locations.

Third Harbor Tunnel Area.
Tunnel Alignment: The Third Harbor Tunnel alignment has been refined and improved. The Proposed Action design shifts the southern end of tunnel alignment slightly eastward so that the tunnel will pass below the Subaru Terminal and will continue beneath the Harbor and into Bird Island Flats in East Boston. The Proposed Action, thus, both moves the tunnel almost all the way out of the slip near General Ship Pier 5 and eliminates the reverse curve, improving geometry. This

shift in alignment virtually eliminates impacts to General Ship, consequently saving many jobs and reducing harbor filling.

Steel Immersed Tube Construction: Steel immersed tube construction has been selected for the Third Harbor Tunnel. The Proposed Action specifies use of steel immersed tubes, constructed off-site and towed into Boston Harbor. Therefore, on-site fabrication of tunnel sections is unnecessary. The material type to be used for the tunnel was an issue identified for further study in the FEIS/R.

East Boston/Logan Airport Area.
Airport Access/Egress Roadways Revised: The Proposed Action design relocates the airport access road to the northeast of the East Boston Memorial Stadium Park to improve traffic operations, and eliminate potential long-term impacts to the park. This design improvement allows East Boston Stadium Park to be significantly expanded, consolidated into one useable space, and become more accessible to the community. Rather than follow the North Area Service Road, as proposed in the FEIS/R, the airport egress road will be shifted further northeast, parallel to the proposed access road.

Toll Plaza Location: Under the Proposed Action, toll collection facilities for the Third Harbor Tunnel would be moved to Logan Airport. Tolls will be collected from westbound vehicles using the Third Harbor Tunnel, the same direction in which the tolls are paid at the existing tunnels.

Vertical and horizontal curves, and thus sight distances, have been improved on the approaches to the toll collection areas, resulting in improved safety conditions. Also, inadequate weaving distances in South Boston have been eliminated; at Logan Airport longer signing distances and separated decision points are possible.

Additional advantages result from this change. Placing the toll collection booths on the ramps and connectors at Logan Airport will enable operators to collect tolls from vehicles which are waiting to merge, eliminating the need for vehicles to make a second stop in South Boston. Another advantage is that operators will be able to meter vehicle flow into the tunnel during peak hours or emergencies, and provide head of the line privileges for HOVs.

Alternatives Considered: Location of the toll plazas is one of the three major changes since the FEIS/R. Please see Chapter 2 of Part IIB of the SEIS/R for a complete alternatives analysis discussion.

The two toll plaza alternatives (either in South Boston, as in the FEIS/R, or at Logan Airport) were analyzed in terms of safety, traffic flow, toll plaza operations, and other environmental impacts, as well as HOV system performance. Aspects of changes in the project since the FEIS/R relevant to the toll plaza alternatives are:

- The project now includes a more extensive system of ramps and exclusive lanes designed to give priority to HOVs.
- The airport interchange has been modified to reduce impacts on East Boston Memorial Stadium Park, and to shift the interchange further from the residential community. This change also moves the airport toll plaza further from residential areas.
- Traffic management technologies have been improved. It is now clear that traffic entering the Third Harbor Tunnel will require metering at both ends to optimize flow.

The Logan Airport toll plaza location is superior to the South Boston location in terms of geometric criteria, toll plaza operations, signage, traffic control, and safety. The HOV system would operate much better with the Logan toll plaza, because it would provide provide an opportunity for HOVs to bypass other traffic entering the Third Harbor Tunnel and would avoid the queuing at the South Boston end of the tunnel that would hamper HOVs from separating from other traffic in the South Boston toll plaza alternative. Locating the toll plaza at Logan also permits improvement of the geometry of the South Boston interchange, benefiting both HOVs and other traffic.

HOV System. An improved high-occupancy vehicle system has been incorporated into the Proposed Action design. The proposed HOV system will operate along portions of both I-93 and

I-90. HOV roadways in and out of the South Station Transportation Center will operate along I-90 on a proposed collector-distributor roadway system as well as exclusive HOV roadways. This collector-distributor system has been incorporated into the design to improve safety by reducing weaving problems associated with local traffic movements. A traffic metering area and equipment will be located near the eastbound portal to the Third Harbor Tunnel to meter all traffic flow into the tunnel during periods of congestion and will provide operators with the ability to give HOVs priority to enter the tunnel, if desired.

Another major component of the system will be the South Boston Bypass Road, which will provide commercial vehicles with a direct connection between the Southeast Expressway near the Massachusetts Avenue interchange and I-90 at the South Boston interchange. The frontage road system near the Massachusetts Avenue interchange will provide the connection between I-93 north- and southbound and the Bypass Road north- and southbound.

Exclusive HOV lanes will not be provided in the Third Harbor Tunnel. However, exclusive lanes will be provided for HOVs approaching the toll plazas at Logan Airport. Emergency response and law enforcement operations will be located at the toll plazas to maintain traffic flow into the Third Harbor Tunnel. In addition, this system will enable operators to favor HOVs as they enter the tunnel.

Tunnel Ventilation. Final locations of ventilation buildings was an issue identified for further study in the FEIS/R.

Evolution of the project design since the FEIS/R has resulted in modified requirements for ventilation, such as redefinition of tunnel lengths, number of travel lanes, and location and length of access and egress ramps.

Seven Ventilation Buildings: The selection of sites for the seven ventilation buildings has resulted from an intensive screening process based on a full range of criteria, including public health and safety, air quality, land use, water resource impacts, visual impacts and historic resources, as well as technical feasibility and costs.

Materials Disposal. Construction of the Proposed Action will result in 13.5 million cubic yards (cy) of dredged and excavated material to be disposed of as follows:

- o 1,205,000 cy to Massachusetts Bay Disposal Site (MBDS)
- o 2,666,000 cy to sanitary landfills
- o 9,283,000 cy to Spectacle Island
- o 379,000 cy to landfills (utilities relocation material)

At Spectacle Island in Boston Harbor these materials are divided as follows:

- o 1,010,000 cy of unacceptable (for ocean disposal) dredged material
- o 800,000 cy of acceptable clay and till for capping
- o 7,272,000 cy of fill, clay, till and other excavated material
- o 201,000 cy dredged rock

Placing the bulk of the excavated fill at Spectacle Island has emerged as the preferred solution for environmental reasons, since the island is currently an abandoned city dump. In its present condition, the island presents a safety hazard. It is unstable, crumbling, and contributes substantially to the pollution of Boston Harbor, leaching 22 million gallons of pollutants into the water annually. There are no inhabitants, no rare or endangered species, and the island's marine life has been substantially degraded due to contaminants in the water.

Placing project fill on Spectacle Island would cap the eroding landfill and create a harbor island park, while eliminating 1,200 truck trips daily from regional roadways - which would otherwise be necessary to carry the fill to inland sites.

Spectacle Island is part of Boston Harbor Islands State Park, but it cannot be enjoyed by the public until the present hazardous conditions are remedied. The Boston Harbor Islands State Park 1986 Master Plan stated:

"Whether or not it is developed for park use, Spectacle requires extensive stabilization to mitigate the environmental impacts of the eroding landfill .. the stabilization project will be most feasible if spoil materials from a major public project such as the Central Artery/Third Harbor Tunnel are utilized."

Alternatives Considered: Materials disposal was one of the important unresolved issues in the FEIS/R. Please see Chapter 4 of Part IIB of the SEIS/R for a complete alternative analysis discussion.

There are several types of disposal sites; each type can accept different materials and is regulated within a different framework. The types of site include inland disposal sites, coastal disposal sites, subaqueous disposal sites, confined marine disposal, and other ocean disposal sites. Different Federal or State regulations apply depending on the type of site to be used or the type of material to be disposed. Each of the most likely sites identified through the site screening process has been evaluated against two basic sets of criteria: (1) practicability, and (2) environmental impact.

In order to determine which of these sites is an available and practicable alternative for the allocation of material, a comprehensive site identification process was undertaken. The site identification process yielded 851 potential disposal sites located throughout the State including three ocean sites, nine nonocean marine sites, and 839 inland sites.

Disposal sites for the different categories of dredged and excavated materials were evaluated separately. It was determined that all of the clean clay and till could be used beneficially either to cap the other materials at their disposal site(s) or to cap currently active coastal landfills.

Detailed environmental assessments were completed for numerous potential sites. The impacts indicated that the use of inland sites for most of the material is impractical. Salinity of the soil would require special treatment for the fill if placed at inland sites near aquifers. Generally, marine sites isolated from residential areas and public water supplies would be better locations for disposal sites, except where existing coastal landfills can be improved by using capping material from the project.

This Proposed Action is recommended based on environmental impact analyses of the types and qualities of materials to be dredged and excavated together with the suitability of the potential disposal sites for various materials.

The use of barges to carry fill to Spectacle Island offers a substantial reduction in truck traffic that would be required to transport fill to inland sites.

S.4 SUMMARY OF ENVIRONMENTAL IMPACTS

There are considerable environmental benefits to the improvements to Artery/Tunnel Project as documented in the SEIS/R. Safety, transportation, air quality, economic, energy conservation, urban design, increased parkland and substantially reduced filling of waterways among others, substantially outweigh adverse impacts, such as some unavoidable filling of waterways. Environmental impacts of the project are presented below in the order that they are described in the SEIS/R.

S.4.1 Transportation

The Artery/Tunnel Project will have beneficial transportation impacts in every part of the study area (central Boston and immediate surroundings). The project will substantially increase the capacity of I-93 and, together with the extension of I-90, result in better traffic operations on local streets from which traffic will be diverted to the regional system.

Other beneficial impacts of the project include better access to downtown Boston and Logan Airport, improved operating conditions for HOVs, and elimination of other deficiencies in the design and capacity of the Central Artery -- the absence of acceleration and deceleration lanes, the prevalence of weaves caused by the high number of entrance and exit ramps within a short distance, and the absence of a continuous north-south surface street system parallel to the Central Artery to distribute off-ramp traffic and collect on-ramp traffic -- that contribute to the congestion and

high accident rate today.

The traffic volume and operations data presented in the SEIS/R have been updated since the FEIS/R, to reflect the more rapid growth in vehicular traffic volumes than anticipated at the time of the FEIS/R and the changes in the project design that will alter the future traffic patterns. The effect of unexpected rapid traffic growth has been to increase projected daily and peak hour traffic volumes, and generally to cause a worsening of estimated traffic conditions without the project, and documents even more strongly the need for the project. In addition, the methodology for analyzing traffic operations has been refined in the intervening years; procedures used in preparing the current document conform to the 1985 Highway Capacity Manual.

Traffic volumes are forecast to average 221,100 vehicles per day along the Central Artery (including major parallel ramps) between Kneeland and Causeway Streets for the Proposed Action, versus 178,800 vehicles per day for the 2010 baseline (if the project is not built) an increase of approximately 24 percent. The Third Harbor Tunnel will carry 96,900 vehicles per day. The underground Central Artery will absorb about 40,000 vehicles daily from city streets onto the interstate highway. Despite the large increase in total peak hour traffic volumes, the Artery will carry 29 percent fewer vehicles per lane on a daily basis -- 21,200 versus an average of 30,000 if the roadway were not reconstructed. It is these lower per lane traffic volumes that will result in reduced congestion and improved travel speeds. Average roadway speeds will increase by 44 percent in the entire study area, and by over 90 percent downtown, as a result of the Proposed Action.

The Proposed Action will achieve improved traffic operating conditions on the expressway system and at local roadway intersections, as measured in terms of level of service (LOS) indicators. Without the project, 87 percent of the expressway links in the core of the study area would operate during the PM peak hour at highly congested LOS F conditions. With the Proposed Action in place, however, the number of LOS F highway segments in peak hours, will be reduced to 21 percent. Among 29 comparable strategic intersections (selected on the basis of potential sensitivity to project-related impacts), 12 and 13 would operate with one or more approaches at LOS F during the AM and PM peak hours, respectively, without the project. As a result of the Proposed Action, however, the number of intersections with one or more approaches at LOS F will be reduced to 7 and 8, in the AM and PM peak hours, respectively.

The duration and severity of traffic congestion also will be reduced markedly. Whereas congestion on various segments of I-93 and Route 1A in the year 2010 is projected to last from 9 to 14 hours per day without the project, congestion at the same locations will be reduced to morning and evening peak hours with the reconstructed Central Artery and new Third Harbor Tunnel in place. The quality of peak hour conditions with the project reflects average speeds of approximately 30-35 mph as opposed to no build conditions when peak hour traffic would travel under 15 mph.

In virtually every section of the study area, the diversion of commuters and other motorists onto the expressway system will result in improved traffic operations on local streets. There are a few specific locations at which the relocation of ramps will cause a localized redistribution of vehicles that is expected to affect traffic conditions adversely in that immediate vicinity. Daily traffic will decline by an average of 9 percent on a cross section of local streets throughout the study area, compared to year 2010 conditions without the project.

The reconstructed Central Artery is expected to operate with far fewer accidents than the existing facility, due primarily to improved geometry and expanded capacity. The annual accident rate on the Central Artery is predicted to decrease by 35 percent with the new facility in place, from 5.47 annual accidents per million vehicle miles travelled (VMT) in the 2010 baseline to 3.54 per million VMT. On the entire study area expressway system, including the cross-harbor tunnels, the accident rate is predicted to decline by 13 percent with the Proposed Action in place.

Congestion-related delays on the Central Artery and in the Sumner/Callahan Tunnels for trips to/from the airport have approximately doubled over the last 10 years. Airport-oriented ground traffic is a major component of total vehicular volumes in the Harbor tunnels and on the Chelsea Street and McArdle bridges. Over 50 percent of

daily traffic through the Sumner and Callahan Tunnels is airport-related. During the PM peak hour, when congestion in the Sumner Tunnel is at its worst, approximately 70 percent of Sumner Tunnel traffic originates at Logan Airport.

The project will provide for a necessary expansion of total airport ground access capacity, and achieve a more efficient access system, through its provision of HOV lanes. The increased use of multiple-passenger modes is critical to the airport's ability to accommodate future traffic demands. The project's HOV system will help produce a higher proportion of bus and multipassenger vehicle trips to and from the airport, and also serve trips to and from downtown Boston.

Although the Proposed Action will result in better traffic operation and other beneficial impacts, there are, nevertheless, roadway segments and intersections on which traffic volumes will increase and operating conditions will require new traffic management techniques as a result of the addition or relocation of ramps. The project is committed to the implementation of a Traffic Surveillance and Control System, which will improve operations on the Artery/Tunnel mainline above forecasted levels.

Public transportation is the principal means of managing the demands placed on area roadways. To promote continued growth in transit ridership, the MBTA has developed plans for continued expansion of capacity, introduction of new services, and implementation of operational improvements that will foster increased reliability. Many of the projects included in the MBTA's capital construction program contribute towards mitigation measures for the Artery/Tunnel Project, both during the construction period and as permanent features of the regional transportation system; most are scheduled to be completed by the year 2000. The four rapid transit lines will have sufficient capacity to serve 34,140 more peak hour passengers (in each direction) than in the base year. Other new transportation services are at the feasibility analysis stage or beyond, and several have a high probability of implementation. Planned improvements to the commuter rail system include system expansion, station construction and upgrading, vehicle acquisition, and more frequent service. New bus terminals will be incorporated into the South Station Transportation Center (under construction) and the new Lynn transit station, and new bus purchases will extend peak hour fleet capacity to accommodate up to 12,000 additional passengers by 1990 and 24,000 additional passengers by 1992, in each direction. In addition, the MBTA has developed a plan for the construction of between 15,000 and 40,000 new parking spaces at rapid transit and commuter rail stations, under its continuing park-and-ride program. The MBTA anticipates that between 15,000 and 20,000 of these spaces will be constructed by 1995.

As part of the Artery/Tunnel Project mitigation program, the Department is planning to provide docking facilities on Lovejoy Wharf near North Station that will be available for private operators of passenger boat service to Logan Airport, South Boston, Charlestown, and possibly a downtown location such as Rowes Wharf. A recently completed study of future water transportation services recommended new service connecting the airport, the South Shore, and downtown Boston. The Commonwealth currently is considering support for this service, and is sponsoring a more detailed study of potential Inner Harbor services, including North Station-based routes.

Construction Impacts. The FEIS/R provided a general discussion of expected traffic disruption resulting from project construction within each subarea. Consistent with the greater level of design development a more detailed description of construction impacts is included in the SEIS/R. Although this information is not technically required in an environmental impact statement, construction impacts are included in some detail, including:

- o Detours and Diversions: The major vehicular and railroad detours required by each stage of construction in the six project subareas have been identified and assessed, and appropriate mitigation measures proposed.
- o Maintenance of Traffic Plan: A preliminary Maintenance of Traffic Plan for vehicular and pedestrian circulation has been prepared; procedures have been outlined for continued development and refinement of this plan during final design in cooperation with public agencies and local communities -- the implementation of this plan is a part of the overall project Construction Management Program.

- o Movement of Materials: The FEIS/R presented a qualitative assessment of new truck traffic generated by construction of the project; the SEIS/R provides a detailed assessment of construction material quantities, and average and peak truck loads per day by year for each project subarea. The SEIS/R also provides a number of truck traffic mitigation actions, including special haul routes to minimize travel on local streets as well as use of barges to reduce truck traffic.

- o Other Impacts: The SEIS/R also presents a detailed discussion of the temporary construction effects on and mitigation measures to maintain pedestrian circulation, public transportation, parking and navigation on waterways in the project area.

S.4.2 Air Quality

The air quality analyses conducted for the Artery/Tunnel Project show that the Proposed Action will:

- o Result in air quality levels that meet all applicable State and Federal ambient air quality standards - all predicted future carbon monoxide (CO) and nitrogen dioxide (NO_2) concentrations with the project are within (less than) applicable standards;

- o Improve CO levels over the no-build case. At 39 key intersections analyzed, 28 will have lower CO levels than the no-build alternative;

- o Reduce areawide vehicular emissions in the region - the project is predicted to result in a 22 percent reduction in CO, a 17 percent reduction in hydrocarbons (HC), and a 7 percent reduction in nitrous oxide compounds (NO_x) emissions in 1998; in 2010, a 22 percent reduction in CO, a 19 percent reduction in HC, and an 8 percent reduction in NO_x are predicted; and

- o Conform to the Massachusetts State Implementation Plan (SIP).

Specifically, air quality studies conducted for the project focus on carbon monoxide, nitrogen oxides, and hydrocarbons. They include the following studies: a description of existing air quality conditions in the study area, an estimate of the in-tunnel air quality concentrations within all of the proposed tunnel sections, an analysis of the impact of the project on carbon monoxide levels at critical locations within the affected neighborhoods along the proposed alignment, and near proposed toll facilities, and an analysis of the impacts associated with proposed tunnel ventilation systems. Air quality analyses were conducted for 1998, the estimated year of project completion and 2010, the project design year. A study was also conducted to select the locations of project ventilation buildings.

Microscale (or localized) mobile source air quality modeling was performed using the U.S. Environmental Protection Agency's (EPA) most recent mobile source emission factor program and a computerized atmospheric dispersion model designed to predict air quality concentrations near congested intersections. Mesoscale (areawide) "pollutant burdens" (i.e., tons of carbon monoxide, nitrogen oxides, and hydrocarbons emitted from vehicular exhaust in the area each day or year) with and without the Artery/Tunnel Project were also estimated. All locations would meet all applicable State and Federal standards.

The tunnel sections of project will be ventilated through a ventilation system designed to meet FHWA and EPA requirements for highway tunnels. The ventilation system planned would duct fresh air to the tunnel from fans housed in a series of ventilation buildings located along the tunnel alignment. Exhaust air would be drawn through ports in the tunnel ceiling by fans located within the ventilation buildings, and discharged to the atmosphere through exhaust ducts at the top of the ventilation buildings. Atmosphere dispersion modeling was conducted to estimate the carbon monoxide and nitrogen dioxide impacts of this exhaust air released through the seven proposed ventilation buildings. These impacts were estimated using both analytical and physical (wind tunnel) modeling techniques and, for predicting nitrogen dioxide concentrations, assumed an atmospheric conversion of nitrogen oxide to nitrogen dioxide.

S.4.3 Noise And Vibration

Additional noise-sensitive sites are identified in

the project area that had not been included in the FEIS/R. Future predicted noise levels with the Proposed Action will be less than noise levels without the project at 22 of the 40 noise receptor analysis locations. At one other location there will be no change. At 14 locations, increases of 1 to 4 dBA will be so minor as to constitute "no impact" (increases of less than 5 dBA are considered barely noticeable to the general public). At three of the 40 locations, there will be increases of 6, 7, and 9 dBA, respectively, considered to be "minor" but noticeable.

Noise abatement measures were considered for 37 of the 40 locations where future noise levels would exceed FHWA criteria -- existing noise levels currently approach or exceed FHWA criteria at 32 of the 40 sites. Noise levels without the Proposed Action would exceed FHWA criteria at 36 of the 40 sites. Noise barriers are considered reasonable and effective for placement at two of these sites.

The Proposed Action will have beneficial effects with reduced levels of vibration as compared to existing and future baseline conditions at all of the 19 nearby locations analyzed. This includes more sensitive receptors than analyzed in the FEIS/R, due to the extended project limits and changes in alignment, but the conclusion of no major impact is consistent with the FEIS/R.

Construction Impacts. Twelve noise-sensitive locations were selected to assess noise impacts during construction. During some construction activities, for 1 to 55 weeks, moderate to substantial noise impacts will occur for short durations at some areas north of Causeway Street and in the Central Area, at the Artists Building in South Boston, and at Memorial Stadium Park in East Boston, depending on the site and construction stage. Minor impacts are expected at all locations during certain stages of construction. Mitigation measures for all impacts will be identified during design development and included in specification documents for section design contracts.

Mitigation of potential noise and vibration impacts on historic buildings will be monitored by a Project Conservator according to established standards. Vibration impacts during construction depend on the degree to which the soil is compacted. Damage will not occur, even to sensitive structures, at a distance of 12 feet or greater from construction activity. Slurry wall construction will be performed near historic buildings to protect against the potential for structural damage. Additional monitoring will be conducted near sensitive buildings very close to construction.

S.4.4 Energy

Energy consumption in the design year 2010 will decrease by some 15 percent with the Proposed Action over consumption levels without the project largely due to improved traffic flow conditions -- a net annual energy savings of 329,476 equivalent barrels of oil (bbl). The analysis in the SEIS/R, which is more detailed than that presented in the FEIS/R, shows that this savings will be composed of reductions in vehicle fuel consumption as a result of increased travel speeds on the highway system after construction of the Proposed Action, offset to some extent by the relatively small amount of energy necessary to operate roadway and tunnel lighting, ventilation, and drainage systems.

Construction Impacts. A onetime, nonrecoverable expenditure equivalent to 2,292,400 bbl would be necessary to complete construction of the Artery/Tunnel Project. This will be offset by the annual direct energy savings in approximately 7 years.

S.4.5 Economic Characteristics

The overall economic impacts of the new Artery/Tunnel facilities, in comparison to the conditions without the project, will be beneficial for the State, the New England County Metropolitan Area (NECMA), Suffolk County, and the study area.

For the NECMA, this represents an addition of 18,000 jobs, $723 million a year of disposable personal income and $1.8 billion in annual sales (expressed as 1987 dollars) in the year 2010, as compared to the 2010 baseline conditions. Within the study area, decreased congestion resulting from the Proposed Action will allow the addition of 20,000 jobs, add $2 billion to total business sales, and allow tourism to reach a level that will add $169 million per year to overall tourist spending.

Without the project, traffic capacity and accessibility limitations of the existing highway system would increasingly constrain employment growth beyond the year 1999. Greater travel time costs for trucking and deliveries, higher wages to attract and compensate commuters, and lost time for visitors would lead to slower growth in downtown office occupancy, and the industrial, retail, and tourism sectors. While some activities would be able to relocate in the suburbs, much of the future economic growth would not occur at all in the Boston metropolitan area without completion of the Artery/Tunnel Project. The major benefit of the Proposed Action will be the avoidance of such congestion-induced losses.

Completion of the Artery/Tunnel Project will provide time savings benefits to a wide variety of automobile and truck travellers who travel to and from downtown Boston, through downtown Boston, or around the Boston area as part of longer trips. Some of these benefits have been accounted for in the economic impact analysis through their effects on business costs. The FEIS/R reported a time savings of approximately 17 million person hours per year as a result of the Preferred Alternative when compared to a 2010 base case forecast from existing conditions at the time of the FEIS/R. The SEIS/R analysis shows a much larger time savings of approximately 60 million person hours per year. This difference is because the SEIS/R forecast of the 2010 baseline anticipates much higher levels of congestion, based on measured changes in traffic since the FEIS/R, and because of the various alignment improvements to the project since the FEIS/R. Overall, the travel delay reductions for car and truck trips represents a travel user benefit of approximately $530 million annually.

State revenue after expenditures associated with the Proposed Action is forecast to be $17.4 million annually (2010), a positive return on investment to the Commonwealth.

Construction Impacts. Overall economic impacts of project construction are expected to be beneficial for the State, the region, and the study area; the benefits of job creation and increased spending resulting from the project should outweigh the temporary negative effects of construction activity on accessibility, retail trade, and tourism. The SEIS/R analysis projects $4.1 billion in total regional sales from an investment of $4.4 billion in the Proposed Action [compared with $4.95 billion (1987 dollars) in sales on a $3.0 billion investment proposed in the FEIS/R]. The availability of a detailed Interstate Cost Estimate for the Proposed Action made it possible to identify the major materials and equipment required for the project and to estimate the percent of imports that are expected to be required from outside the region. Total direct, indirect, and induced construction period employment estimated in the FEIS/R was 77,000 person years over 12 years (6,500 jobs per year average), which is somewhat higher in total than the 71,000 person years (8,900 per year average) currently estimated for the Proposed Action, a larger project with a shorter construction time than the FEIS/R. This difference exists because the Proposed Action has a higher material content relative to labor content due to extensive tunnel construction and because a larger fraction of the new jobs is now projected to be created outside the region.

No effect on the office market as an impact of project construction is anticipated. The retail sales estimates have been revised from the FEIS/R to take into account the new, larger study area (with a larger retail base), new information on shoppers' modes of access, and recent case studies of other downtown construction projects. Carefully managed mitigation can limit losses to 2 to 5 percent of automobile-dependent sales, rather than the 10 to 20 percent losses stated in the FEIS/R. This loss would be more than offset by the sales gains resulting from the construction work force and extra income to other workers estimated to be approximately $51 million per year for the metropolitan area. Tourism will be subject to potential losses of somewhat less than 1 percent of total sales over the construction period; this effect may be obscured by normal annual fluctuations influenced by the weather, the summer price of gasoline, the dollar's exchange rate, and the overall business cycle.

S.4.6 Land Use And Neighborhood Characteristics

The density of development in Boston has increased substantially since the FEIS/R, primarily in the Central Area, due to new office/retail projects. Growth and new development in project subareas have added to existing traffic and thus increased the need for the Proposed Action. The Artery/

Tunnel Project will provide improvements in both access and the visual environment to keep pace with ongoing development activities, but general land use patterns will not change as a result of the project. Since the alignment of the Proposed Action and its tunnel, structure, and on-grade elements are similar to what was described in the FEIS/R, the land use impacts in most subareas will not be significantly different from those described in that document.

The long-term impact of the Proposed Action on neighborhoods and community facilities is generally expected to be beneficial; removing the elevated Central Artery barrier between the waterfront and North End and downtown and improving access among these areas, providing opportunities for the expansion of the North End, Chinatown, and East Boston neighborhoods, and reducing "short-cut" traffic in all neighborhoods.

Alignment modifications throughout the corridor will generally create new opportunities for positive land use changes, such as providing landscaped buffers on adjacent parcels not needed for highway use to reduce impacts on residential areas.

The major design improvements since the FEIS/R affecting land use include the following:

- o The realignment in the Area North of Causeway Street will reduce impacts to the south bank of the Charles River, reduce impacts to pedestrians along Causeway Street, and moves the project further away from the historic residential area of City Square in Charlestown and the Paul Revere Landing Park on the north bank of the river. Right-of-way required for the new ramps and bridges on the north side will continue a transportation and industrial corridor which has existed in the area for 150 years. However, 70 percent of the riverbanks on both the Cambridge and Boston sides would be made into an extension of the Esplanade park.

- o Design refinements in the Central Area will decrease the number of open roadway sections for ramps, providing more opportunities for reuniting the city and improving pedestrian and vehicular connections between adjacent areas across the top of the roadway tunnels.

- o The relocation of the northbound segment of the Central Artery from along Fort Point Channel to under Atlantic Avenue, and the redesign of the I-93/I-90 Interchange, will reduce impacts to Fort Point Channel and will create opportunities to improve the edges of Chinatown now severely compromised by existing roadways.

- o The inclusion of the South Boston Bypass Road as a part of the project will reduce truck traffic on local streets and, in conjunction with the Seaport Access Road, would be compatible with development plans for northern South Boston.

- o Alignment modifications in East Boston will allow for the expansion of East Boston Memorial Stadium Park and for the substantial improvement of connections between the park and the community.

The placement of the Central Artery underground will allow joint development opportunities throughout the alignment, including approximately 27 acres of developable land in air rights above and adjacent to the tunnel between the North End and Chinatown. Joint development opportunities (that is, possibilities for physical development including parks in space under, over, or adjacent to the alignment for nontransportation purposes) are the subject of a detailed joint development planning process developed for the SEIS/R.

The Artery/Tunnel Project will not involve any residential relocations, and the number of business employers to be relocated has been reduced since the FEIS/R. A total of 131 businesses employing 4,400 persons would have been relocated as a result of the project as described in the FEIS/R, while the Proposed Action will displace 134 businesses employing approximately 4,100 persons. The reduction in employment disruption is due primarily to the change in the project alignment in the Area North of Causeway Street. A detailed explanation of all anticipated relocation impacts and the process for relocation is contained in the Conceptual Relocation Report, an appendix to the SEIS/R.

In addition to the general land use impacts related to changes in roadway right-of-way and accessibility, the project will have specific land use

impacts resulting from the construction of a number of support facilities. Support facilities to be constructed as a part of the Artery/Tunnel Project include seven ventilation buildings, replacement parking, emergency response unit buildings, and toll plaza administration facilities.

S.4.7 Visual Characteristics

Major improvements in the design since the FEIS/R include moving the Charles River bridges west, away from Charlestown's City Square and Paul Revere Landing Park, and relocating the I-93/Storrow Drive Connector ramp away from the south bank of the Charles River. Another design improvement is the relocation of the airport access ramp to the northeast side of the East Boston Memorial Stadium Park, minimizing its impact on the park.

Most visible and positive will be the impacts in the Central Area. In particular, the existing Central Artery viaduct and ramps which have covered a 22-acre path through the heart of downtown Boston -- dividing neighborhoods, inhibiting pedestrian and vehicular circulation, and creating an environment of shadows, exhaust fumes, and traffic noise -- will be removed. This viaduct will be replaced with a tunnel between Congress and Causeway Streets, and the surface over the tunnel will be restored with improved signalized, city streets in a conventional circulation pattern, creating opportunities for a variety of new open spaces and buildings.

Other project architectural elements will change the character of the visual environment and alter the aesthetic experience for motorists and pedestrians in various locations throughout the project area. These include large segments of viaduct structure primarily in the South Bay Cambridge-Charlestown railroad yards, and airport areas, depressed open roadway sections primarily at Logan Airport, and the industrial area of South Boston and also at ramp locations downtown, a new toll plaza at Logan Airport, administration facility, and seven new ventilation buildings. North of Causeway Street, three new bridges across the Charles River, one of which is double-decked, will replace the existing high bridge with lower, wider bridge decks. Multilevel concentric ramps will encircle the commuter rail tracks, Boston Sand & Gravel plant, and the Millers River in Cambridge and Charlestown, historically a transportation and industrial environment. Special attention to the design and architecture of all of these elements includes: forms, structural materials, colors, textures and secondary elements such as lights, signs, guard rails, and barriers; the design of landscape within the project corridor, and the incorporation of complementary uses will ensure that the overall visual affect of these elements on the urban landscape will be enhanced.

Construction Impacts. The SEIS/R identifies generic and site-specific construction impacts including mitigation measures or negative impacts. Construction facilities and activities visible to motorists, pedestrians, airport passenger, office workers, and residents that are addressed in the SEIS/R include: concrete batch plants; barge loading facilities; the casting basin for the Fort Point Channel tunnel sections; construction areas; demolition; excavation; underpinning and retaining walls; night lighting; movement of construction equipment and materials; disturbance of landscape; temporary bridges, ramps, roadways, and pedestrian walkways; temporary access to public transportation; temporary signage; anchored barges for tunnel section placement, and barricades and fences.

S.4.8 Historic Resources

The inventory of historic resources in the vicinity of the proposed alignment was updated as part of the SEIS/R process. The Proposed Action will have less adverse effect on historic resources than did the project as described in the FEIS/R. Of the 412 historic structures inventoried, only three, the House of Bianchi, the Old Colony Railroad bridge, and Railroad Tower A, would be directly affected by the project. In the FEIS/R design there were seven historic sites affected.

Improvements in the project since the FEIS/R have eliminated or will mitigate impacts on the Causeway/North Washington Streets District, and the Fort Point Channel Historic District. Mitigation measures have been identified for project impacts on the Blackstone Block District, the Oliver/Purchase Streets District, Russia Wharf and the newly eligible Gridley Street District, and the Leather District and South Station Headhouse.

Construction Impacts. Pursuant to a Memorandum of Agreement among the Department, FHWA, the

State Historic Preservation Office (SHPO), the Boston Landmarks Commission, and the Advisory Council on Historic Preservation, a Project Conservator was appointed to oversee "the development of measures for mitigating the adverse effects of construction on standing historic properties. These mitigating measures shall be included as part of the construction specifications." The Project Conservator issued a preliminary report in 1988 analyzing those structures adjacent to or in the project area that might be affected by unmitigated vibration levels, alteration of groundwater levels, and/or uncontrolled ground movement during construction. Project design and construction specifications will be reviewed by the Project Conservator as developed so as to minimize or prevent effects to all identified structures.

S.4.9 Archaeological Resources

The FEIS/R contained recommendations for completion of archaeological site identification. These surveys prepared by Boston University were carried out as a part of the SEIS/R.

The Phase I survey encompassed 89 study blocks and their intervening streets, traffic islands, or bodies of water using the National Register of Historic Places and other criteria for identifying potentially significant sites such as: prehistoric sites, settlements, wharves, landfills, manufacturing and industrial sites and transportation-related facilities. Of the 89 study blocks, 75 were determined to contain either no intact or insignificant archaeological resources as a result of recent construction activities. Portions of six study blocks were identified as containing potentially significant archaeological resources, but these portions are not within the impact corridor of the Proposed Action. Eight study blocks were recommended for Phase II archaeological field investigation. Additional historical research, utility research, and field remote sensing as a part of this Phase II program established that two sites were either inaccessible or destroyed, and they were eliminated from the field testing program.

The Phase II investigation revealed significant findings at only one of the study blocks near the North End, but three distinct significant archaeological sites are contained in this one block: the Mill Pond Wharf site, the Paddy's Alley site, and the Cross Street Backlot site. The Mill Pond Wharf site contains the intact remains of a wharf structure, documented through historical research and archaeological context to have been constructed between 1672 and 1709. The Paddy's Alley site is a house lot which was a part of a larger 17th century estate that fronted on North Street and was owned from ca. 1656 through the remainder of the 17th century by the Paddy family. The Cross Street Backlot site, adjacent to the Paddy's Alley site, has a different site development history -- this site is unique because it is believed, based on historical and archaeological evidence, that it was always an "open lot," i.e., no primary buildings (houses, barns, stores, etc.) were built on it until the construction of the Central Artery.

The Mill Pond Wharf site, Paddy's Alley site, and Cross Street Backlot site each meet the criteria for eligibility for listing on the National Register of Historic Places based on the information contained in each site. In addition, a Phase I archaeological survey of Spectacle Island confirmed the existence of a prehistoric (late archaic period) archaeological site listed as part of the Boston Harbor Islands National Register Archaeological District. The information in these sites can be retrieved only through excavation. The Artery/Tunnel Project will undertake Phase III data recovery activities at all four sites to retrieve scientifically the significant information contained in them. The Phase III data recovery program will include research, fieldwork, laboratory analysis, conservation of fragile specimens, report preparation, and public exhibition of results. The program will be reviewed and approved by the SHPO's office before implementation.

S.4.10 Utilities

The proposed utility plan has developed considerably since the FEIS/R as a result of a more thorough analysis of existing utilities located in the project area. Refinements in the project alignment, as well as the installation of new utilities since 1985, also have redefined the scope of work.

There are 29 miles and seven types of major utilities located within the right-of-way: wastewater facilities, storm drains, water mains, and electric, gas, telephone, and steam lines. Individual lines run at different depths and in different

directions, often wrapping around obstacles as encountered. Because of these irregular configurations, work on a given utility line sometimes can cause service disruptions in neighboring networks.

The Artery/Tunnel Project presents a unique opportunity to modernize the maze of existing utility lines within the project alignment. The project will take advantage of this opportunity to build utility corridors, specially constructed underground channels within which various pipes and conduits are placed, as a part of the Proposed Action. This method is designed to limit service disruptions during construction, and to minimize traffic congestion associated with utility changes, and allow efficient maintenance of utility lines long after the project is completed. Another major long-term impact of the Artery/Tunnel Project on utilities will be the replacement of often antiquated facilities with modern installations. These changes will improve utility service in Boston.

Construction Impacts. The SEIS/R discusses utility relocation scheduling and construction traffic control measures. It includes a thorough discussion, by project subarea, of all relocation work. In the Central Area, from Congress to Causeway Streets, all relocations will be made under a separate contract prior to the commencement of construction of the Artery/Tunnel Project. From Kneeland to Congress Streets, utility relocations will be carried out by the general contractors, but will be made before general construction work begins. In all other areas, relocation work will occur simultaneously with general construction work, with some important exceptions: (1) work will start early on the New East Side Interceptor, which will lie within the project limits, in the South Bay area, and on the relocation of a major gas main entirely outside of project limits, and (2) in East Boston, the Porter Street outfall and a new electrical substation and sewer pump station will be built prior to the start of general project construction in that area.

S.4.11 Water Quality

The amount of intrusion into bodies of water has been substantially reduced since the FEIS/R, due to design improvements moving the alignment out of and away from water wherever possible.

The most important improvement in the program since the FEIS/R is in Fort Point Channel, where the northbound Central Artery tunnel has been entirely removed from the Channel in the area north of the Dorchester Avenue bridge. In addition, the previously proposed total filling of the area south of the Dorchester Avenue bridge has been reduced due to the improved design of the I-90/I-93 Interchange. Approximately 20.8 acres in Fort Point Channel would have been filled in the FEIS/R design; this has been changed to 8.4 acres under the current Proposed Action and has resulted in a 60 percent reduction of encroachment of Fort Point Channel.

In Boston Harbor near the General Ship dry dock, there will be filling of approximately 3,145 square feet of Harbor bottom, which had not been included in the FEIS/R. This amount of filling is negligible within the context of the volume and waterplane area of the Boston Inner Harbor, and is unavoidable in order to accommodate the geometric alignment of the southern approach to the Third Harbor Tunnel.

The removal of the Leverett Circle Connector from the Lower Charles River also has resulted in a 91 percent reduction of encroachment in the river area and the near elimination of filling in the river; the net amount of filling will be 24 square feet of river bottom, considering both the new piers and the existing piers to be removed. Approximately 3,200 square feet of filling will be required in the Millers River for bridge piers which were not identified in the FEIS/R; this filling will not have any incremental effect on the flow of the Millers River, already constrained by the two culverts at its mouth. Because the Millers River is already highly degraded, and contains effectively no life, the incremental impact on water quality will be minor.

The total amount of stormwater generated will not change significantly; however, the proposed transportation system will change the drainage patterns and the rate of storm flows discharged at each location.

The project will alter the total roadway surface area exposed to precipitation, increasing surface roadway in some sections, and decreasing it in others, especially where existing surface roads are being placed in tunnel. As a result, storm-

water flows will increase in some areas and decrease in other areas. This will be especially true in the Central Area, where interstate traffic on the existing Central Artery will be in tunnel, and no longer contributing pollutants to the stormwater flows in the area. In addition, the pollutant loadings in stormwater should be decreased as a result of vehicle exhaust emission mandated by the Federal and State Clean Air Acts. All these factors will affect the amount and characteristics of stormwater runoff.

Many of the current storm drainage systems serving the project area are discharged to combined sewers, which increases the frequency and duration of combined sewer overflows (CSOs) to Boston Harbor, and adversely impacts the Deer Island sewage treatment plant. As a result of project construction, separate storm sewers would be added reducing the overflow of CSOs and improving treatment at the Deer Island plant.

Stormwater drainage from the new Artery/Tunnel Project system is now, and would continue to be, predominantly tied into Boston Water and Sewer Commission's (BWSC) main drainage system and treated with the system as a whole.

Because tunnel washdown water will be discharged to combined or sanitary sewers for treatment at the Massachusetts Water Resource Authority's (MWRA) Deer Island sewage treatment facility, there will be no impact from this source on water resources. These discharges will be pretested if necessary to meet MWRA and BWSC effluent limits. Sewage will be generated at a small number of locations, such as the administration buildings and toll plaza. Sewage also will be discharged to sanitary or combined sewers for treatment at Deer Island. There will be no impact on water resources from the generation of sanitary wastewater.

During and after construction, existing industrial users of surface waters, such as the Gillette Company, will be able to continue using the water sources that they presently use, and implementation of the project will not interfere with the activities of others to clean up Boston Harbor.

Construction Impacts. The SEIS/R estimates volumes of suspended solids that can be expected during the dredging of Boston Harbor and also explains how those materials will be distributed and will eventually resettle. The SEIS/R discusses how losses of dredged materials during construction in the water would be minimized and states that such mitigation measures as silt curtains will be evaluated during final design, and presents a detailed analysis of construction impacts on marine resources, including benthic organisms, crustaceans, anadromous fish, shellfish, and marine mammals. Most species will avoid the project areas under construction; some fish and benthic organisms will be killed by underwater blasting and dredging. In either case, repopulation of all disturbed areas by existing inhabitant species is expected after construction. The SEIS/R identifies specific periods of peak fish migration and spawning, during which dredging work should and will be curtailed. No impacts to terrestrial ecology and endangered species are foreseen.

The SEIS/R classifies impacts on the use of seawater for industrial needs as a temporary construction impact, identifies specific mitigation measures for the Gillette Company, and recommends possible mitigation measures for two firms (Hook Lobster and General Ship) that were not included in the 1985 document.

Both the SEIS/R and FEIS/R address groundwater and water table impacts, stating that specific plans for dewatering and/or water injection will be developed during design; the SEIS/R presents a detailed outline of criteria, instrumentation, data collection, evaluation, and corrective actions involved in such a program.

A projectwide emergency response program will be developed and implemented, and a spill cleanup firm will be retained during construction. There will be unavoidable temporary impacts on some coastal and inland wetland resources due to construction activities. Following construction, disturbances will cease, banks will be restored, and disturbed wetlands will be replaced in the same location.

S.4.12 Wetlands And Waterways

The water bodies evaluated in the SEIS/R are the Lower Charles River including the Millers River, Fort Point Channel, Boston Inner Harbor, and Boston Outer Harbor. The waterways resources (such

as navigational and industrial uses) and the wetlands and water resources (that is, biological characteristics such as aquatic uses by fish and wildlife and their functional significance) are considered for each water body. While existing conditions in the project area have not changed much since the FEIS/R, the project now includes the Millers River and substantially eliminates filling in the Charles River and Fort Point Channel that were affected by the previous alignment. A narrow bank of bordering vegetated wetlands adjacent to the Millers River and a narrow 10-foot strip of bordering vegetated wetlands on the west bank of Upper Fort Point Channel will be affected.

Approximately 17 new cylindrically shaped piers 15 feet in diameter will be placed in the waters of the Charles River to support the three new bridges. In addition, there will be ramps and a cloverleaf structure east of and above the Millers River; eight new piers will be placed in the Millers River. The existing Central Artery bridge over the Charles River will be demolished. Placement of the bridge piers in the Charles River will displace a net area of 24 square feet of river bottom. The river banks would not be disturbed beyond pier placement. Long-term impact will be negligible. Neither the flood storage nor the water-carrying capacity, effectively controlled by the new Charles River dam, will be diminished. Since the piers are small and cylindrically shaped, they will cause a minimal amount of hydrodynamic disturbance, and they are to be placed sufficiently upstream so that any disturbance to the flow will not affect the proper functioning of the pumping station downstream. Water velocity of the Charles River also is slow enough so that any disturbance to the flow would have minimal effect.

The number of piers located in the water would create different conditions for river navigation. However, the piers would be located to allow a 300-foot barge, the largest vessel which can physically lock through the dam, to navigate safely below the bridges with the aid of two tugboats. Further studies may result in refining the bridge design so as to reduce the number of piers of water.

The piers crossing the Millers River will displace 3,200 square feet of river bottom, adjacent banks, and bordering vegetated wetlands. The reed grass stands, although generally of low quality, do perform flood control and storm damage functions by anchoring the banks and slowing water runoff speeds; they also reduce pollution somewhat by filtering sediments. This loss, however, is not anticipated to have a serious impact on the resource area's ability to provide storm damage prevention or flood control since the banks of the river are high. It is expected that the piers will not obstruct water circulation and flow of water into the Charles River.

The bordering vegetated wetlands at Millers River do not perform public or private water supply or groundwater supply functions. The Millers River is very polluted due to the high degree of industrial uses along its route for the last century and a half. Analysis of the river water shows that only limited life exists there.

The water provides only minimal wildlife habitat. Currently, it is estimated that 6,400 square feet of the bordering vegetated wetlands will be lost. Mitigation for the remaining loss of inland and coastal resource areas will be accomplished by restoring disturbed wetlands and creating a new wetland area to replace filled wetlands. Wetland restoration involves restoring a disturbed wetland to its original nature. Wetland creation involves replicating the lost wetland area in an upland location.

Spectacle Island is another wetlands area. Presently, the dump at Spectacle leaches 22 million gallons of pollutants annually into the waters at Boston Harbor. This degradation of water quality would be substantially improved by the project's proposal to cap the island.

Construction Impacts. See Water Quality above.

S.4.13 Floodplains

It is expected that there will be no measurable impacts to existing flood storage capacity. Floodplain encroachment will take place at two saltwater tidal locations, namely Fort Point Channel and the slip east of the General Ship dry dock in South Boston. It also will take place in freshwater nontidal locations, namely, the Charles and Millers Rivers between the old and new dams. Design improvements made to this project since the

FEIS/R have deliberately reduced the amount of floodplain encroachment by 60 percent in total surface area and by 66 percent in total water body volume. The major areas of water body (or flood storage capacity) reduction occur in the Fort Point Channel area, 76 percent less, and in the Charles River area, 86 percent less.

Further studies since the FEIS/R demonstrate that the fill in the slip east of the General Ship dry dock in Boston Inner Harbor and the piers in the Millers River are insignificant in quantity in comparison to the entire body of water within the project limits. The total quantity of fill will displace less than 0.002 percent of the entire floodplain area, that is, less than 3.5 acres of the Boston Inner Harbor that falls within the limits of the project; this will result in no measurable rise in sea level.

S.4.14 Vegetation And Wildlife

The overall impacts of the Proposed Action have not changed due to the limited amount of vegetation and wildlife resources within the project alignment. The project will have substantial open space benefits from placing Central Artery underground. There also will be increased landscaping opportunities in East Boston and the Fort Point Channel area, and marine habitats will be increased by providing the dike around Spectacle Island. (For impacts on marine species and wetlands habitats, see Water Quality and Wetlands and Waterways above.)

S.4.15 Construction Staging And Sequencing

Construction staging and sequencing was one of the issues for further study from the FEIS/R. A Replacement Parking Program, Maintenance of Traffic Plan, and Mitigation Program have been developed as part of the SEIS/R.

The Proposed Action is being planned, designed, scheduled, and organized to minimize disruption. Surface traffic in the Central Area will be maintained by phasing construction activities so that a minimum of three lanes of north- and southbound capacity between High and North Streets and two lanes of north- and southbound capacity between North Street and North Washington Street are available throughout the construction period. Some of this capacity will be obtained by the elimination of parking along the Surface Artery, Atlantic Avenue, and Purchase Street, and by street crossings and detour routes described in the Maintenance of Traffic Plan. The mitigation program relies on experience with local projects, which have been constructed successfully under similar conditions (such as the Southeast Expressway reconstruction and the MBTA Red Line and Southwest Corridor) and knowledge gained from large urban transportation projects in other cities; it will be developed further, modified, and refined as the project is implemented, in response to public agency and local community review, final design refinements, and more detailed understanding of the temporary effects of construction as they occur and evolve.

Roughly half of the project will be constructed within the existing I-93/Central Artery right-of-way, and half on a new right-of-way through developed industrial areas of South Boston and Logan Airport. Almost 40 percent of the project will be underground in tunnels, open cuts, or depressed boat sections, with the remainder involving at-grade roadways, viaducts, and bridges. Immersed tube tunnel sections will be used to cross Fort Point Channel and the Boston Inner Harbor. Cut-and-cover tunnels will occur throughout the Central Artery portion of the project adjacent to the North End and downtown Boston, as well as for sections of roadway in the I-93/I-90 Interchange, South Boston, and Logan Airport. Transition sections from tunnel to grade and surface roadway will be built throughout the project, with the most extensive such segment being the South Boston Bypass Road. Elevated roadways (both viaducts and bridges) will be the predominant type of construction in the Area North of Causeway Street; including bridges over the Charles River, the I-93 Southeast Expressway and Massachusetts Avenue interchange area, and the Logan Airport access and egress road. The types of construction, methods, equipment, special measures, and materials which will be utilized in these areas are described in the SEIS/R.

The overall project, and each subarea, will involve a complex logistical support system for the provision and delivery of construction materials, removal and disposal of excavated, dredged and demolished materials, and space to accommodate the needs of contractors and construction workers, including temporary storage and parking. These

topics are discussed in great detail in the SEIS/R.

As was discussed in the FEIS/R, special measures will be taken to assure the integrity and operation of affected facilities and structures and to provide for public safety. These measures include tunnel protection, underpinning overhead and adjacent structures, a movement and vibration monitoring program. In addition, a conveyor system for the removal of excavated material is being considered for the Central Area.

A carefully phased and coordinated construction program has been developed. This program is based on overlapping design and construction phases, and dividing the work into contract "packages" to permit timely completion of the project. Approximately 85 separate contracts will be awarded in a sequence geared to achieve the project overall completion schedule. Accordingly, numerous contracts will be in progress at the same time, and the award of certain contracts will be dependent on completion of work by preceding contracts. The sequence of work for the entire projects is designed to minimize the magnitude and duration of traffic disruption.

Utility relocations, demolition, and the installation of construction support facilities are scheduled to begin first for all areas, and heavy construction will start soon thereafter. The South Boston Haul Road is planned to be completed early in order to reduce construction vehicle movements on existing streets and minimize traffic disruption during construction of the I-93/I-90 Interchange and the Seaport Access Road. By 1994, the immersed tube tunnel to Logan Airport is scheduled for completion. It will be opened to trucks and commercial vehicles, thus reducing congestion in the I-93 corridor during the second half of the construction period.

Approximately 4 years following completion of the Third Harbor Tunnel, the eastern extension of I-90 from I-93 under Fort Point Channel is scheduled for completion along with most of the new I-93/I-90 Interchange. The I-93 portion of the Artery/Tunnel Project is expected to begin carrying traffic in the northbound direction by 1996, and to be operational in both directions by 1997. The entire project is projected for completion, including removal of the existing elevated structure and restoration of surface streets, by the end of 1998.

During the early planning and preliminary design phase of the project, construction management planning is concentrated in the areas of identifying construction methods, development of a contract packaging strategy, development of construction management procedures, material and resources planning, and development of strategies to mitigate the impacts of construction on the environment and the community. Much of the preliminary construction management planning effort has already been accomplished and is described in Chapter 20 of the SEIS/R. The process of interactive construction and mitigation planning with the community continues after the publication of the SEIS/R, moving into the more detailed phase, which occurs during final engineering design.

During final engineering, more than 30 section design consultant (SDC) contracts will be awarded to various architectural/engineering firms to carry the design from the preliminary (approximately 25 percent) completion level to the final (100 percent) completion level. As the design develops, site-specific design requirements and construction issues, traffic controls, and mitigation requirements will come into greater focus. A number of site-specific issues will be addressed and resolved with the affected parties during this process, including:

- o maintenance of access to buildings by vehicles and pedestrians
- o maintenance of local street access and emergency access
- o noise and vibration control during day and night shift operations
- o coordination with building owners and tenants of utility service shiftover to new service
- o other site-specific issues related to the functioning or operation of adjacent facilities

In conjunction with the Mitigation Program Office described in the SEIS/R, construction management will interact with various affected groups (including building owners, tenants, community groups,

public agencies, and the SDCs). The needed requirements and restrictions that govern the manner in which the contractor may perform the work will be identified and incorporated into the design documents and construction contracts.

Design refinements and numerous methods and special measures have been developed for the project which will result in more efficiently managed construction.

Potential nuisances associated with construction include pests (such as rodents and cockroaches) and odors associated with construction and excavation activities. Rodent control was one of the commitments made in the FEIS/R to minimize disruptive influences of construction. The development and implementation of the rodent control program for the Artery/Tunnel Project is unique; this is the first time in the United States that a comprehensive rodent control program has been developed and implemented as a part of a major construction project; leading authorities in rodent control have been engaged to provide the latest technology and state-of-the-art control practices.

S.5 AREAS OF CONTROVERSY

Issues and areas of controversy identified during the course of the SEIS/R, including those raised by agencies and the public, are listed below. SEIS/R chapters where the issues are addressed are identified in parentheses (). Both of these areas had been unresolved issues in the FEIS/R.

- Impact of that part of the Proposed Action crossing the Charles River on parklands, wetland, and other land use [2; 3; 8; 13; 14; 15; Part IIB, Chapter 1; Part III, Section 4(f) Evaluation].

- Demonstration that the Spectacle Island alternative, which involves filling waters of the U.S. (land under water and wetlands), is the least damaging practicable alternative for some materials disposal (Part IIB, Chapter 4).

S.6 MAJOR UNRESOLVED ISSUES

The following issues are not fully resolvable with agencies having jurisdiction until the project enters subsequent phases of project development. SEIS/R chapters where the issues are addressed are identified in parentheses ().

- Based on recommendations of the DEP, BWSC, MWRA, EPA, City of Cambridge Conservation Commission, Massachusetts Division of Marine Fisheries, and USACE, the project is proceeding with a separate stormwater system design. If treatment is required for any portion of the discharge, an evaluation of various treatment approaches will be undertaken. This issue of stormwater management will continue to be evaluated in the context of the regional water quality planning now underway by DEP, EPA, MWRA, and BWSC (13).

- EPA has requested more detailed analyses of traffic, air quality, and noise impacts during construction. Air quality and noise impact assessment of identified traffic conditions (that is, detours and diversions during various stages of construction) could not be analyzed for the SEIS because: (1) interim year(s) traffic data were not available, (2) the identified detours and diversions were based on preliminary design, and may change during final design, and (3) the detailed information on construction phasing and sequencing required to make reasonable air quality scenario assumptions at the subarea level will not be available until final design. The detailed assessment of the air quality impacts of proposed maintenance of traffic plans will be completed using the same detailed microscale air quality dispersion modeling procedures used to assess operational impacts, upon finalization of such plans, during final design (20).

- Appropriate and effective specific mitigation measures to carry out the SEIS/R's proposed generic mitigation actions identified in the Maintenance of Traffic Plan will be selected during final design, based on the availability of more detailed traffic and construction information, planning, and interaction with public agencies and local communities abutters (20).

S.7 OTHER FEDERAL ACTIONS REQUIRED FOR IMPLEMENTATION OF PROPOSED ACTION

- o Section 10 Permit (construction and dredging in navigable waters -- Boston Harbor) - U.S. Army Corps of Engineers.
- o Section 103 Permit (Marine Protection, Research and Sanctuaries Act) for ocean disposal of dredged material - U.S. Army Corps of Engineers.
- o The Section 106 (National Historic Preservation Act of 1966) Review will be completed.
- o Section 404 Permit (dredge spoils disposal) - U.S. Army Corps of Engineers.
- o Section 401 Water Quality Certification (U.S. Clean Water Act) - Administered by the Massachusetts Department of Environmental Quality Engineering, Division of Water Pollution Control.
- o Federal Aviation Regulations, Parts 77, 151, 152 - Federal Aviation Administration.
- o Construction agreements for railroad relocation - Amtrak and Conrail.
- o U.S. Coast Guard permits for new bridges over navigable waters.
- o U.S. Coast Guard permit for alterations of existing bridges.
- o U.S. Coast Guard approval for work in Boston Harbor.
- o National Pollution Discharge Elimination System Permit - U.S. Environmental Protection Agency.

S.8 SECTION 4(f) EVALUATION

S.8.1 Introduction

Section 4(f) of the Department of Transportation Act of 1966 states that no Federal Highway Administration action will use land from a significant publicly owned park, recreation area, or wildlife and waterfowl refuge, or any significant historic site, unless (1) there is no feasible and prudent alternative to use of land from the property; and (2) the Proposed Action includes all possible planning to minimize harm to the property resulting from such use.

Portions of parkland and historic resources will be permanently or temporarily used by the Central Artery/Tunnel Project. These resources, project impacts and mitigation measures are described in the Section 4(f) Evaluation in FEIS/R. Part III of the SEIS/R documents that through design improvements, it has been possible to reduce 4(f) impacts most notably in Chinatown, the Charles River Crossing, Fort Point Channel, and East Boston. In this summary of findings, project impacts and mitigation measures to parklands are discussed first, followed by historic resources. There is no 4(f) use of archaeological resources in the project corridor.

S.8.2 Parklands

Four publicly owned parks will be affected by the Proposed Action because of a permanent taking or a construction period use: two in the Area North of Causeway Street, the East Boston Memorial Stadium Park, and a designated proposed park at Spectacle Island in Boston Harbor. Nine additional parks are near the Proposed Action, but none will be used or impaired by the project.

Paul Revere Landing Park. The Proposed Action will permanently use 0.69 acre of the south bank portion of Paul Revere Landing Park for the I-93 transition section between the Central Artery tunnel portal at Causeway Street and the bridge structures crossing the Charles River. The transition section would displace 73 parking spaces used by the MDC and others. On the north bank portion of the park, no land would be used and parkland expansion plans would be possible. There would be no impact on pedestrian movement between North Station and Charlestown over the walkway on the Charles River dam locks or in either bank of the park. There would be no shadow impacts for the bridge structure over the walkway. The Proposed Action would, however, have substantial visual impacts due to the large size of the bridge structure. In comparison with the FEIS/R the impacts on Paul Revere Landing Park on the north bank of the Charles River have been eliminated and

impacts on the MDC dam and south river bank have been substantially reduced. The two highway ramps to Causeway Street which interfered with pedestrian access to Paul Revere Landing Park have been eliminated. Finally, no ventilation buildings would be required in the area.

Leverett Circle/Storrow Drive. At Leverett Circle/Storrow Drive/Esplanade, which is part of MDC's Charles River Reservation, the Proposed Action would permanently use 0.3 acre of parkland. Because Leverett Circle will be reconfigured to provide for a new at-grade intersection, the Proposed Action will add 0.27 acre of new land with landscaping. The FEIS/R documented a construction period impact on the Esplanade for a temporary roadway, as well as permanent fill along the south bank of the Charles River east of Leverett Circle to accommodate a highway ramp. Through design improvements, 4(f) impacts have been avoided in the preferred alternative.

The Department will implement the following parkland mitigation measures due to the adverse visual impacts of the Proposed Action in the Lower Charles River area, despite the relatively minor permanent use of parkland. This sensitive area is planned by the MDC as an easterly expansion of the Esplanade to connect with Boston Harbor.

- Paul Revere Landing Park: The south bank portion of the Paul Revere Landing Park will be restored after construction. On the north bank, the park will be expanded north and west to the Central Artery North Area project (CANA) ramps and new bridges, landscaped as a major element in the riverfront park system, and connected by landscaped walkways through the CANA construction area and to Charlestown.

- The CANA Chapter 91 Waterways License, Special Conditions: These conditions will be revised and implemented on the land owned by the Department, which will be transferred to the MDC on completion.

- Lovejoy Wharf Walkway and Ferry Terminal: A pedestrian walkway and a commuter ferry landing facility will be constructed on Lovejoy Wharf.

- New Pedestrian Environment: An attractive pedestrian environment will be developed on the east and north sides of the Charles River bridge transition section and abutment, between Paul Revere Landing Park (south bank) and Causeway Street.

- New Portal Plaza: A small urban plaza marking the entrance to Paul Revere Landing Park will be constructed as a part of the Proposed Action above the Causeway Street portal of the I-93 tunnel.

- Viaduct Design: The structural design will be compatible with the park improvements.

- Charles River Bridge Design: Alternative Charles River bridge design features will continue to be considered, including haunched girder and cable-stayed structures.

- Design and Construction of New Parkland: The Department will pay for the preparation of an overall master plan, design and contract documents for two major MDC properties essential to the completion of the Charles River park system and for the park development of these properties. These are the designated MDC Nashua Street parkland on the south bank of the Charles River and the former GSA site, which will be a major MDC park node, on the north bank.

- Reconfigured Leverett Circle Area: Improvements to Leverett Circle will be provided as a part of the Proposed Action, including landscaping of a larger reconfigured parkland area as well as reconstruction of pedestrian overpasses. Landscaping in the area will be compatible with the Charles River Esplanade ambience and will create an attractive visual terminus to Storrow Drive.

East Boston Memorial Stadium Park. The Proposed Action will not permanently use any of this City of Boston park. Air quality impacts of the Proposed Action will not exceed Federal or State standards and will not affect park use. Minor increases in noise will not impair use of the nearest adjacent facilities, like the east baseball field. A minor noise impact is predicted to occur at the east end of the Memorial Stadium Park at the tennis courts. During construction there will be some temporary use of the park edges

for ramp demolition and construction, and access to the park will be affected by a construction haul road and temporary airport shuttle bus detours.

Mitigation measures suggested include installation of a 1,700 foot-long, 16 foot high noise barrier along the north, east, and partially along the south edges of the park. Landscaping would be extended to the south, providing a new southeast access point to the park.

In comparison with the FEIS/R, there is considerably less impact on the park. The proposed design expands the park by relocating the inbound airport roadway, and elevated bus ramps currently dividing the park, to the park's northern edge.

Spectacle Island. The Artery/Tunnel Project would use Spectacle Island for the placement of excavated and dredged material. This activity will provide capping for the existing abandoned landfill and stabilize the island in a manner that is necessary to implement the Harbor Islands State Master Park Plan as specifically envisioned in the plan document. The island, owned by both the City of Boston and the Massachusetts Department of Environmental Management, would be regraded and revegetated in a manner consistent with future park use. This element of the Proposed Action was not included in the FEIS/R.

S.8.3 Historic Resources

Potential impacts of the Proposed Action on historic resources have been evaluated. In addition, the stipulations of the Memorandum of Agreement (MOA) signed in 1984 have been addressed in the SEIS/R. Specific impacts on historic resources in the study area are as follows.

Charles River Basin Historic District. Reconfiguration of Storrow Drive at Leverett Circle and the construction of an eastbound traffic tunnel under the Circle will not affect the historic Street Railway Viaduct over Leverett Circle or other contributing features. The Proposed Action has thus been determined to have no adverse effect on the District.

Causeway/North Washington Streets Historic District. The Proposed Action would have the positive effect of removing the Central Artery viaduct which would visually reconnect the two historic portions of the Bulfinch Triangle. In addition, design of the northbound I-93 ramp beginning at Traverse Street and passing under Causeway Street would remove traffic congestion from that area. The Proposed Action avoids the impacts of the 1985 FEIS/R Preferred Alternative (i.e., taking of the contributing Stop & Shop and Charles River Buildings, as well as impacts of the previously proposed ventilation building and the ramps at Causeway Street on the Stop & Shop loading dock). The only adverse effect of the Proposed Action is due to construction period impacts such as vibration which will be mitigated area under the terms of the MOA.

Fort Point Channel Historic District. The Proposed Action, Atlantic Avenue alignment (I-93 northbound), will substantially reduce impacts to the Fort Point Channel Historic District compared to the 1985 FEIS/R Preferred Alternative. The northbound Central Artery tunnel structure has been removed from the Channel, avoiding use of land in and along the west edge of the Channel and altering the bulkhead north of Dorchester Avenue. In addition, the Summer Street and Congress Street bridges will not be disturbed, as in the previous FEIS/R design.

The Seaport Access Road portion of the Proposed Action continues to require replacement of the Old Colony Railroad Bridge (1896-98). In addition, construction of the Seaport Access Road tunnel (and graving basin for tunnel section assembly) will continue to require the removal and replacement of approximately 400 feet each of the east and west portions of the historic Fort Point Channel bulkhead.

The Proposed Action includes a ventilation structure for the Seaport Access Road (ventilation building 1) located just west of the Dorchester Avenue bridge. Portions of this building will be within the boundary of the Fort Point Channel District and on land which would be made by filling the area between the Dorchester Avenue bridge and the Old Colony Railroad Bridge. This new bulkhead line will be granite-faced. The Proposed Action alignment will continue northeast through South Boston, crossing the Fort Point Channel District. The Proposed Action will also require, as did the 1985 Preferred Alternative, demolition of the House of Bianchi, which is a contributing element

though not individually eligible for the National Register.

The Broadway bridge within the Fort Point Channel District has been newly inventoried since 1985 as individually eligible for the National Register. The bridge's draw span and its supporting center pier stonework (1874-75) are the most significant historic elements of the center-swing bridge. These historic features are not expected to be directly affected by the construction or operation of the project; however, serious structural problems threaten the viability of the bridge, independent of the project. Construction of the new northbound Frontage Road will require an at-grade intersection with the bridge between piers 16 and 17, thereby altering the appearance of the western approach span. Relocation of the railroad Wye Connector under the Broadway bridge also will require structural modification of the bridge at this point for vertical clearance, and potentially require the replacement of one bridge pier for lateral clearance.

Measures To Minimize Harm To Historic Resources. The Section 106 Memorandum of Agreement signed in 1984 stipulated several measures to mitigate the effects to the Fort Point Channel Historic District. These measures will be implemented as applicable to the Proposed Action.

S.8.4 Archaeological Resources

Based on additional archaeological surveys undertaken since 1983, no archaeological site affected by the Artery/Tunnel Project meets the criteria for preservation in place, and therefore there is no 4(f) use of archaeological sites in the project corridor.

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PART III

Chapter 1 – Introduction

Chapter 1
INTRODUCTION

1.1 PURPOSE OF SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT/ REPORT

This Supplemental Environmental Impact Statement/Report (SEIS/R) presents updated design studies for the Central Artery (I-93)/Third Harbor Tunnel (I-90) Project (Artery/Tunnel Project) in Boston, Massachusetts, and assesses changes in the project since the Final Environmental Impact Statement/Report (FEIS/R) for the project was published in 1985.

The Artery/Tunnel Project will depress and widen the Central Artery (I-93) through downtown Boston to Charlestown, and will construct (as an extension of I-90) a new Seaport Access Road through South Boston connecting to a new tunnel under Boston Harbor to Logan Airport in East Boston. This regional transportation improvement was proposed for environmental analysis in 1983 and was formally reviewed under the National Environmental Policy Act (NEPA) and the Massachusetts Environmental Policy Act (MEPA) from 1983 through 1985. The FEIS/R for the project was approved by the United States Department of Transportation Federal Highway Administration (FHWA) and the Massachusetts Executive Office of Environmental Affairs (EOEA) in January 1986.

The FEIS/R recommended a Preferred Alternative, known as Alternative 5A Modified. Since the approval of the FEIS/R, subsequent design studies for the Artery/Tunnel Project have included further planning, engineering, and environmental reviews of the Preferred Alternative by the Massachusetts Department of Public Works (the Department). These further reviews were undertaken to address issues (see Table 1.1) identified by the reviewing agencies as needing further investigation in the design phase, and to address other comments received on the FEIS/R. This study process has resulted in more detailed designs and/or design refinements and certain changes to portions of the project. The updated design is referred to as the Proposed Action in the SEIS/R.

The purpose of this SEIS/R is threefold. First, the SEIS/R describes project modifications since 1985, and assesses the comparative environmental impacts of those project changes for which more than one design approach was pursued during the interagency coordination process subsequent to the FEIS/R. These comparative discussions are contained in Part II of this SEIS/R. Part II focuses primarily on four particular project elements; it describes, reviews, and compares the environmental impacts of the alternative options that were considered for each of these four elements, and identifies for each a preferred option for inclusion in the Proposed Action. Part II of this SEIS/R also describes a series of lesser design modifications which have evolved since 1985 or are currently under consideration in the design process.

Second, the SEIS/R provides a general project update on design, engineering, and environmental studies undertaken for this major and complex project since 1985. Part I of this SEIS/R provides the body of this general project update, with reference to various appendices containing more detailed technical information on various subjects. The project update materials respond specifically to the 1986 EOEA Certificate on the FEIS/R calling for

Table 1.1

DESIGN DEVELOPMENT TO RESOLVE OUTSTANDING ISSUES AS IDENTIFIED IN THE FEIS/R PROCESS

Issue	Resolution Or Status	Further Discussion
Identification of disposal sites for excavated and dredged material	Analysis of alternative materials disposal approaches has been undertaken, and three sites are recommended. The Massachusetts Bay Disposal Site is recommended as the site for disposal of 1.2 million cubic yards of dredged materials. Spectacle Island in Boston Harbor is recommended as the site for disposal of 9.3 million cubic yards of excavated and dredged materials. Sanitary landfills would receive the remaining 2.7 million cubic yards of clean material usable for capping. An additional 379,000 cubic yards of excavated materials as a result of utility relocations would be disposed of at existing coastal landfills.	Chapter 20 and Part II of SEIS/R Materials Disposal Appendix SER Chapter 9
Selection of tunnel fabrication site	The choice of steel tubes allows tube sections to be fabricated in existing shipyards and towed to the site from long distances, allowing contractors a wide choice of shipyards. Nine potential outfitting sites for finishing the sections have been identified in the Boston area.	Chapter 20 SER Section 6.6
Selection of material for immersed tube tunnel construction	Prefabricated steel shell tubes are recommended for the cross-harbor tunnel.	Study of Subaqueous Tunnel Alternatives Report SER Section 6.6
Design of Charles River crossing, with special attention to minimizing the effects on the Charles River, existing and proposed MDC park facilities, navigation, traffic on Storrow Drive, and North Station public and private development plans.	Extensive analysis of four families of alternative design schemes has been undertaken. As compared to the FEIS/R design in this area, the three new options assessed in detail have less impact on existing parks and historic resources, better support traffic flow on Storrow Drive and development in the North Station area, and provide opportunities to enhance the riverfront park system. The recommended option Z Modified avoids major filling in the Charles River and impacts on historic buildings, and improves pedestrian access from the Causeway Street area to the MDC dam and Charlestown.	Chapter 2 Parts II and III of SEIS/R [Section 4(f) Evaluation] SER Section 2.1
Approvals of all required Federal, State, and local permits	Coordination with permitting agencies has been undertaken and will continue, the necessary permits and approvals have been identified, and permit applications are being prepared. The SEIS/R provides information to support permit applications, and to facilitate decision-making by agencies with permit jurisdiction.	Permits and Approvals Appendix
Extent of Federal aid construction funding for specific project components	Funding for the Proposed Action was clarified with passage of the Federal Highway Act of 1987.	None

Table 1.1 (Cont.)

DESIGN DEVELOPMENT TO RESOLVE OUTSTANDING ISSUES AS IDENTIFIED IN THE FEIS/R PROCESS

Issue	Resolution Or Status	Further Discussion
Establishment of a process to assure environmentally sensitive future joint development activity with full citizen and agency participation	A process has been proposed and described which allows all concerned parties to participate in determining future uses of new parcels created by the project. The joint development parcels have been redefined for the entire project area.	Joint Development Appendix
Location and height of ventilation buildings	Locations have been proposed for seven ventilation buildings through a detailed site selection process; heights have been determined through preliminary design.	Chapter 2 Chapter 4 Air Quality Appendix SER Sections 3.4, 4.4, 5.4, 6.4, 7.4, and 8.5
Extent of additional work related to archaeological resources and mitigation of impacts on these resources	The Phase I, Step 2/Phase II Archaeological Survey is complete. One National Register listed and two National Register eligible sites that will be affected by the project have been identified. Mitigation plans consistent with the Section 106 Memorandum of Agreement have been approved.	Chapter 11 Archaeological Resources Appendix Archaeological Investigations of the Central Artery/Third Harbor Tunnel Project Report
Construction sequence and staging of the project	An overall construction plan that details the various activities, methods, schedule, and sequencing has been developed.	Chapter 20 Construction Appendix SER Sections 2.5, 3.5, 4.5, 5.5, 6.5, and 7.5
Identification of appropriate staging areas for construction	Construction work areas have been identified for each of the project subareas as part of the construction plan.	As above
Construction impacts on traffic, air quality, and noise levels in the project area	Temporary construction impacts on transportation and the environment have been identified, and measures to mitigate potentially negative effects have been proposed.	As above
Further study of business relocation impacts	Businesses that will be relocated by the refined alignment have been identified. The Proposed Action will displace 134 businesses (employing 4,100 persons) as compared to 131 businesses (employing 4,400 persons) in the FEIS/R.	Conceptual Relocation Report Appendix
Selection of sites for replacement parking	Parking spaces to be taken by the project have been identified and potential replacement sites for public spaces have been proposed.	Chapter 3

1. SER: Supportive Engineering Report (an appendix)

Source: Massachusetts Department of Public Works and Bechtel/Parsons Brinckerhoff

further informational public circulation of detailed planning documents regarding construction impact mitigation and other issues of interest to citizens. In addition, this wide distribution of information to the public is consistent with NEPA regulations that permit optional supplementary environmental documentation that generally furthers the purposes of NEPA. Accordingly, this project update is presented in order to provide for the broadest possible public and agency understanding of and input into the detailed design development of this important and highly visible public project. The updated project design studies also incorporate relevant information about changes in the affected project area and in the transportation network since 1985.

Third, the SEIS/R presents studies and analyses relevant to the specific subject matter jurisdiction of the various environmental permits for the project required from local, State, and Federal public agencies. This information is contained in the appendices, and also in Part I and Part II where the assessment is relevant to permit decisions. These studies, while not intended to serve as final permit applications which will necessarily involve additional technical materials, are intended to provide a common information base for permit agencies, NEPA/MEPA review, and to support further agency analysis and decision-making in the permit process.

1.2 PURPOSE AND NEED FOR ACTION

The FEIS/R for the Artery/Tunnel Project presented the need to improve both the capacity and safety of the existing facilities, based on traffic levels in 1982 and projected levels for the year 2010. Since the preparation of the FEIS/R, the need for improvements has intensified as the metropolitan area experienced unforeseen growth in new office space, employment, and vehicle ownership and use. The consequent increase in traffic by 1987 already exceeded the levels previously forecast for the year 2010. Current forecasts indicate that future traffic levels will overwhelm existing facilities, resulting in widespread congestion for up to 14 hours a day and curtailing economic growth.

The purpose and need for action stated in the FEIS/R are demonstrably still valid today. The major purposes are:

- o To increase capacity, reduce congestion, and improve the flow of traffic along the Central Artery (see Figure 1.1) from the Charles River to the interchange with the Massachusetts Turnpike (I-93/I-90 Interchange); reduce traffic congestion and improve traffic flow on streets and highways in the project area, including those that connect to the Central Artery; and improve system safety.

- o To complete I-90 in Massachusetts and to double cross-harbor capacity and improve access to Logan Airport.

- o To increase accessibility to the South Boston seaport area.

Design modifications since the FEIS/R serve the following additional purposes:

- o To improve the flow of commercial traffic through South Boston via a north-south South Boston Bypass Road between I-93 and extended I-90.


Traffic entering Callahan Tunnel to East Boston/Logan Airport.


Central Artery looking north from Quincy Market Area.


Central Artery looking south from North Station area.


Central Artery looking south toward Aquarium.


Aerial of Central Artery in Central Area.

FIGURE 1.1

Central Artery Congestion

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

- o To further increase capacity of mainline segments with an expanded and improved high-occupancy vehicle system.

- o To further minimize environmental impacts.

The Artery/Tunnel Project includes key elements of the eastern Massachusetts regional highway system (see Figure 1.2). This network includes two circumferential highways (I-495 and I-95/Route 128) with a principal east-west radial (I-90, the Massachusetts Turnpike), a principal north-south radial (I-93, including the Southeast Expressway), and other major radial highways. The part of the Boston metropolitan area affected by the Proposed Action has been defined as the study area for this SEIS/R (see Figure 1.3). The study area includes central Boston, South and East Boston, the South End, South Bay, Newmarket, North Dorchester, Back Bay, Prudential/Copley, and Charlestown neighborhoods, and parts of East Cambridge and eastern Somerville. This area is slightly larger than the study area described in the FEIS/R. Analyses of environmental and functional effects and socioeconomic impacts were focused on the SEIS/R study area.

Consistent with the description presented in the 1985 FEIS/R, the project will increase highway capacity in the Boston metropolitan core by the addition of new highway capacity both north-south and east-west. Along Interstate 93 north-south, the project will create eight through lanes, with additional operational lanes where mandated by highway geometric standards, replacing an existing facility which has four through lanes at its narrowest point, and six lanes for most of the alignment. In the east-west segment, the project will extend I-90 easterly and add four new lanes under Boston Harbor, effectively doubling the capacity of the existing cross-harbor tunnels. The updated Proposed Action, like Alternative 5A Modified, the Preferred Alternative of the 1985 FEIS/R, incorporates both the widened/depressed Central Artery, and the Seaport Access Road alignment for the extension of I-90.

The various elements of the Proposed Action are shown in Figure 1.4 and are described in detail in Chapter 2.

1.3 HISTORY OF PROJECT DEVELOPMENT

The Central Artery was completed in 1959 and was not designed to modern interstate highway standards. It now must cope with traffic volumes more than double those expected to use the facility at the time of its design, as a result of subsequent urban development and enormous growth in automobile use. The many design deficiencies as well as the visual and functional barrier represented by the Artery's elevated structure have been criticized since the date of opening.

By 1974, a study funded by the Department and conducted by the Boston Redevelopment Authority (BRA), the City's planning agency (<u>Central Artery Depression Preliminary Feasibility Study</u>, October 1974), confirmed the engineering and construction feasibility of depressing the Artery. The need for a Third Harbor Tunnel was projected as early as 1957 by the Department.

Analysis of regional transportation requirements in 1983 concluded that both the Artery depression and the Third Harbor Tunnel were necessary to accommodate current and future

traffic demands. Eligibility of the costs of the project for Federal funding was clarified in April 1987, when Congress passed the Surface Transportation and Uniform Relocation Assistance Act.

The approved 1985 FEIS/R discussed in detail 14 alternatives and concepts, including a no-build option, that were considered in the FEIS/R process before selecting the Preferred Alternative. Also, 11 transit options were discussed and evaluated, with the conclusion that future traffic demand could not be adequately satisfied by transit improvements alone. It was recognized, however, that transit improvements could supplement the service provided by the proposed highway improvements, and provisions for improved bus service across the Harbor were included in the alternative selected by the Commonwealth. In addition, the Massachusetts Executive Office of Transportation and Construction has undertaken major improvements in the transit system serving the study area as part of its overall regional transportation plan.

1.4 MAJOR POLICY ISSUES AFFECTING PROJECT DEVELOPMENT SINCE 1985

Over the period of conceptual design refinement and issue resolution between 1985 and 1990, several major policy themes have dominated the design development process. Among these major themes are:

- The need to minimize impacts on and facilitate public use of waterfront areas.
- The need to minimize impacts on parkland and open space and to design transportation facilities which will improve parkland conditions.
- The need to deal creatively and effectively with the problems of disposing excavated and dredged materials and the impacts of the disposal process.
- The need to integrate the proposed interstate highway project effectively into the local street network, particularly as it relates to truck traffic and other problems for the local street network.
- The need to integrate the project elements into a larger regional public transportation and high-occupancy vehicle strategy.

Many of the project changes reported in this document have been influenced by one or more of these major policy considerations. This section summarizes the nature of the important design changes in the context of these policy themes.

Policy Theme 1 -- The Need To Minimize Impacts On And Facilitate Public Use Of Waterfront Areas. The project has been modified to minimize impacts on, and to expand public access to, water-dependent uses of waterfront areas along Fort Point Channel, the Charles River, and the Boston Seaport in the South Boston Piers area.

The northbound alignment of I-93 has been relocated out of Fort Point Channel to its proposed configuration under Atlantic Avenue. This design refinement eliminates filling along the west edge of the Channel and alteration of the Channel bulkhead and bridges in

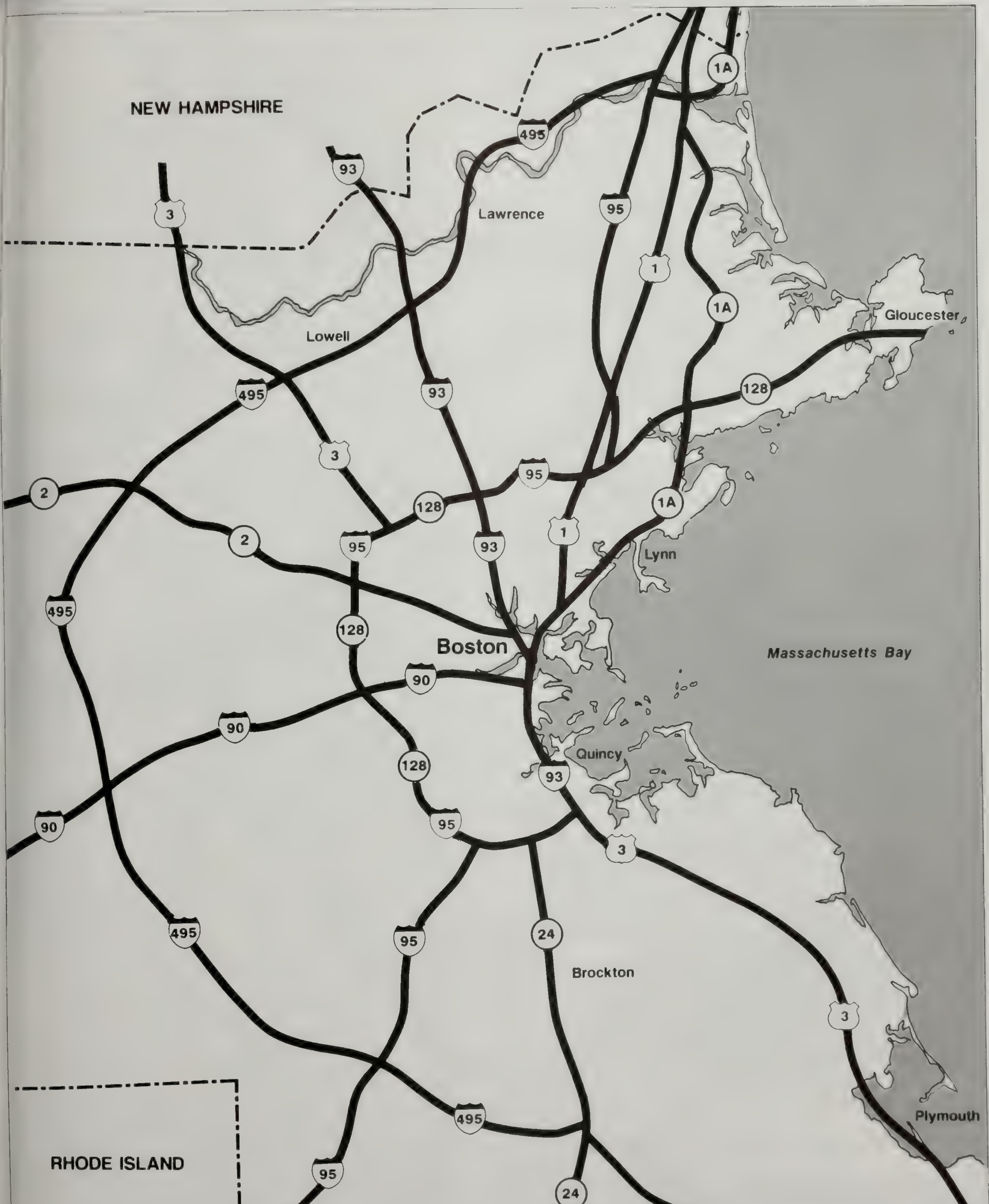


FIGURE 1.2 **Regional Highway System**

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

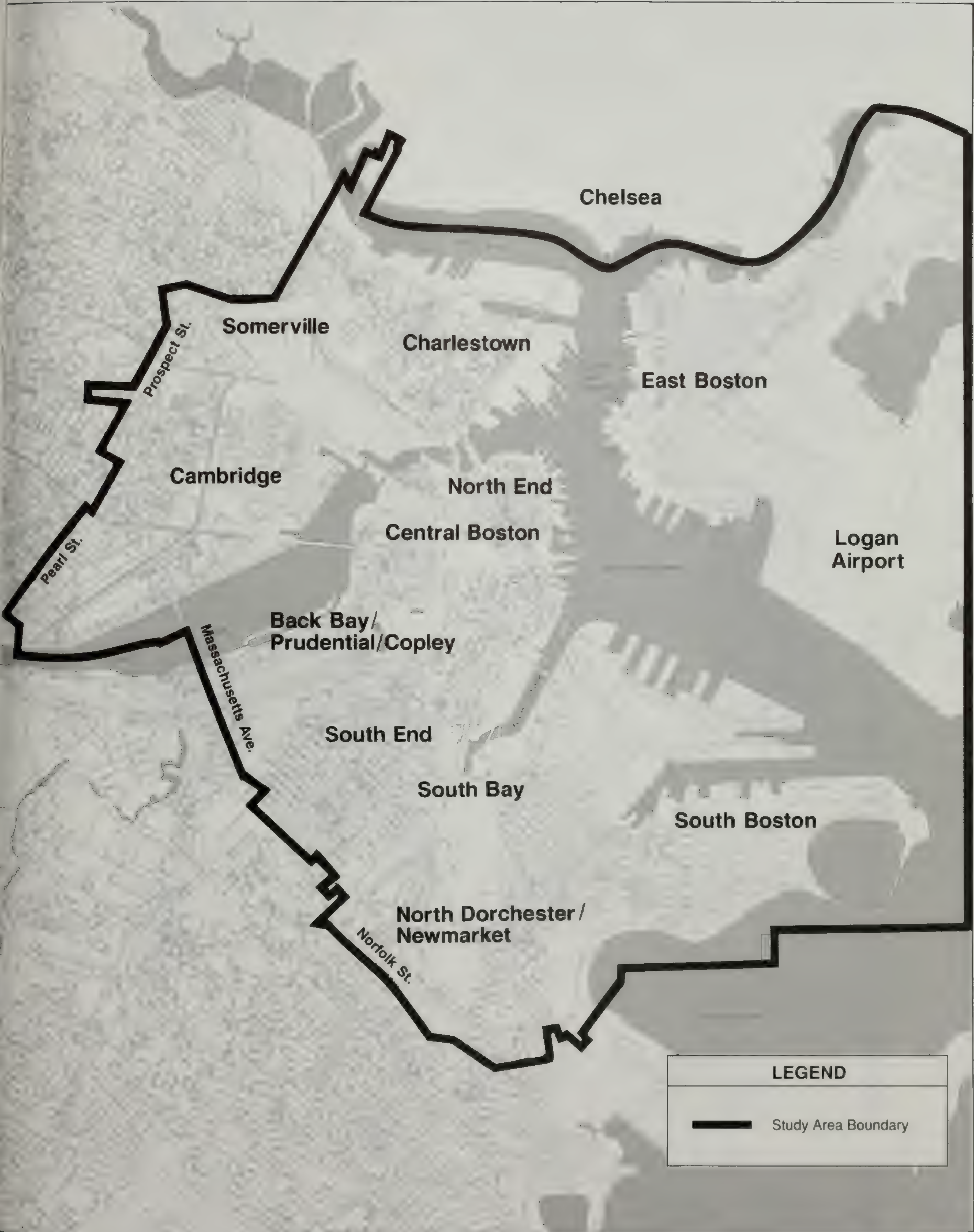


FIGURE 1.3 **Study Area**

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

FIGURE 1.4 **Proposed Action - Central Artery/Tunnel Project**

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

0 400 800 1600 Feet

this area north of Dorchester Avenue. The 1985 FEIS/R design also called for filling of the South Bay generally between the present Dorchester Avenue bridge of the U.S. Postal Service and the West Fourth Street Bridge. Design modifications selected since 1985 now allow for the boundaries of the open water areas to remain substantially as they exist today.

Design changes in the Area North of Causeway Street (a project subarea) were initiated to fulfill a policy commitment to minimize filling in the Charles River. The Proposed Action has relocated an originally planned ramp which would have filled in the edge of the Charles River generally in the vicinity of Nashua Street and the new Suffolk County Jail. Beyond this change, extensive analysis of alternative design options has been undertaken to develop a Charles River crossing which supports and improves public access to and use of waterfront parks and open space along the Charles River. The Proposed Action provides the opportunity to extend the Charles River Esplanade along both banks of the river, to provide pedestrian and bicycle connections along the river to the Charlestown and Boston Harbor waterfronts, and to provide new public water transportation facilities near North Station.

In the South Boston Piers area, the 1985 alignment called for the construction of the cross-harbor tunnel in the slip generally between the General Ship Company and the Massport/Subaru loading area. Research into the implications of construction in this slip of water established that a revised alignment could improve roadway geometrics and avoid potential relocation impacts to water-dependent activities such as active ship maintenance facilities in this Designated Port Area.

Policy Theme 2 -- The Need To Minimize Impacts On And To Enhance Parklands And Recreation Areas. The 1985 FEIS/R reported possible intrusion into parklands in Charlestown and East Boston, and the elimination of an active recreation area in Chinatown. In each geographic area, the design changes incorporated into the Proposed Action will reduce the prior impacts, and will result in major increases in available parkland over the existing conditions.

Charlestown: The 1985 FEIS/R alignment crossed directly over a section of the existing Paul Revere Landing Park in Charlestown, as well as over a pedestrian crossing of the Charles River Dam, owned by the Metropolitan District Commission, the region's park agency. The Charles River crossing options including the Proposed Action described in this document are located further upriver, away from the Paul Revere Landing Park, and allow for expansion of the waterfront park. In addition, the relocation of a ramp originally planned along the edge of the Charles River has made possible the development of new MDC parkland near Nashua Street. Specific project mitigation features developed since 1985 will also allow for continuous pedestrian and bicycle connections along the north (Charlestown and Cambridge) and south (Boston) banks of the Charles River, linking the MDC's Charles River Esplanade with the Boston Harbor waterfront park areas.

East Boston: The 1985 FEIS/R noted that the I-90 alignment would cause the temporary taking of a strip of the existing East Boston Memorial Stadium Park. Since that time, a series of design changes have been adopted which allow for the existing park to expand by more than 7 acres. These changes, which are consistent with Section 4(f) requirements to avoid parkland takings, result in improved roadway geometry, both compared with the 1985 design and with existing conditions.

Chinatown: The 1985 FEIS/R noted that the ramp system in the I-93/I-90 Interchange area would require the elimination of Pagoda Park, an active interim recreational area leased by the Massachusetts Turnpike Authority to the City of Boston. The Proposed Action has been redesigned to avoid this recreational area. In addition, the designs have been changed to eliminate the present southbound off-ramp to Beach Street which, in conjunction with the redesign of the Surface Artery called for in the Proposed Action, will create a major new parcel along the northerly edge of the Surface Artery between Essex Street and Beach Street. Some of this new land area -- particularly the land immediately surrounding the Chinatown Gate -- can be used for a new parkland/recreational area for Chinatown.

Boston Harbor Islands State Park: As discussed below, the Proposed Action's recommended material disposal process would result in the reclamation of Spectacle Island from its currently unusable state for park land purposes, to a facility which can play a major positive role as part of the Harbor Islands State Park system.

Policy Theme 3 -- The Need To Manage Materials Disposal Creatively And Effectively. The 1985 FEIS/R included materials disposal as one of the remaining outstanding issues that would have to be resolved in subsequent environmental documentation. In studies since 1985, alternative materials disposal sites and approaches have been analyzed and a specific plan proposed to deal with the substantial amount of dredged and excavated materials displaced by the project. The plan calls for the use of valuable Boston blue clay to serve as a material for capping sanitary landfills in the Boston area needing this treatment, consistent with an objective stated in the 1985 FEIS/R. The excavated materials would go primarily to Spectacle Island, with secondary amounts going to other destinations as determined in the specific permitting processes to be required. The use of Spectacle Island as the primary location for the excavated materials would accomplish the closing of an existing landfill which is currently polluting Boston Harbor waters, and would create additional and more stable environmental resources around the island shores.

Policy Theme 4 -- The Need To Integrate The Project With The Local And Arterial Street System, Particularly In Terms Of the Problem Of Truck Traffic. The design refinement process undertaken between 1985 and 1990 has resulted in several modifications in roadway segments which improve the operation of local streets.

South Boston: The 1985 FEIS/R made reference to the need to provide mitigation measures to minimize the impact of heavy construction vehicle traffic on South Boston. Earlier environmental documentation has described the impact of an immediate-action Haul Road to be constructed along the Conrail right-of-way, generally between Dorchester Avenue and Congress Street, consistent with the stated intention expressed in the 1985 FEIS/R. The Proposed Action, as described in this document, incorporates a larger roadway improvement, creating an improved connection from I-93 at Massachusetts Avenue to the Massport Haul Road which connects directly with the Boston Marine Industrial Park of the seaport area. This new connector will serve interstate traffic, particularly trucks carrying inflammable cargo which will not be allowed on the I-90 Seaport Access Road. The South Boston Bypass Road, as this new connector is referred to in this SEIS/R, is the most important contribution of the Proposed Action to the goal of improving the condition of local streets affected by truck traffic.

Central Artery Area/Northern Avenue: In the 1985 design, southbound traffic from I-93 destined for Northern Avenue was forced to make a U-turn pattern at Pearl Street and use

Atlantic Avenue northbound to gain access to the Northern Avenue bridge. In the Proposed Action, the southbound ramp has been moved to Oliver Street, allowing a simple left turn movement onto the new Northern Avenue bridge. The elimination of the U-turn movement is particularly relevant to the flow of trucks into the Northern Avenue seaport industrial area.

Central Artery Area/Haymarket: The 1985 design called for access to the Callahan Tunnel for local traffic to occur at a very short, difficult ramp from North Street, forcing trucks and other vehicles through the North Street/Blackstone Street intersection, which is the location of the region's most active public food market. The Proposed Action has relocated this entrance to a new location at New Chardon Street, allowing truck and other commercial traffic to enter the tunnel without use of the immediate edge of the open-air market.

South Bay Area: The proposed design for the reconstruction of the I-93/Massachusetts Avenue interchange now incorporates a series of at-grade intersections between the I-93 frontage roads, the Massachusetts Avenue/Melnea Cass Boulevard roadway system, and the proposed South Boston Bypass Road. This new intersection of I-93 will eliminate an undesirable left-hand exit and a subsequent left-hand entrance from the present configuration of I-93 northbound, and will better facilitate truck traffic throughout the Newmarket industrial area.

Policy Theme 5 -- The Need To Integrate The Project Into The Broader Plan For Public Transportation And High-Occupancy Vehicles In The Study Area. The Proposed Action incorporates several design refinements to implement the policy goal of improving the intermodal characteristics of the project. Examples of such design changes to bring about or to coordinate with major intermodal components are located at Logan Airport, the South Boston tunnel portal, South Station, and North Station.

Logan Airport Toll Plaza Area: The 1985 FEIS/R stated that buses would be given priority access into the four-lane tunnel under Boston Harbor in each direction, but did not specify the precise engineering geometric solution that would make this possible. The 1985 Preferred Alternative also placed the one-way tunnel toll plaza at the South Boston end of the tunnel.

The Proposed Action incorporates a "head-of-the-queue bypass" feature for both directions of the tunnel, consistent with the stated intention of the 1985 FEIS/R. Since the "one-way" toll collection function must occur on the westbound roadway (to be consistent with the other harbor crossings), the relocation of the toll plaza to Logan Airport immediately before the westbound tunnel portal provides an optimal mechanism for metering traffic and giving priority to buses and other HOV traffic. Since all vehicles will now be stopped before they enter I-90 highway system via the tunnel, the HOV preference can be much more effectively accomplished.

Here, the priority metering mechanism for HOV traffic will occur through the operation of the toll gates. The entrance to the two westbound lanes will be metered using the state-of-the-art mechanism often referred to as "smart highways." Buses and other high-priority vehicles will have a separate lane from general purpose traffic, and will be given priority access into the tunnel facility. A police/emergency response system will be located as part of the westbound metering facility.

South Boston/Tunnel Portal: In the eastbound direction, no toll gates are available to control the rate of flow into the tunnel. Thus, a system of traffic signals will be used to meter flow and to give priority to HOVs entering the tunnel. A police emergency response system will also be incorporated at the location of the eastbound metering system.

Airport Blue Line Station: The 1985 design called for access to the westbound I-90 Third Harbor Tunnel from Route 1A to occur over the existing inbound airport roadway. As documented in the 1985 FEIS/R, this caused a major weave section to occur before the off-ramp connection to the tunnel. Additional flyover ramps at this location were complicated by the fact that the ramp was surrounded by land owned by the Boston Parks and Recreation Department. The Proposed Action includes the relocation of these ramps away from the parkland, and eliminates the present mezzanine level of the MBTA Airport Station. As a result, the project will provide a replacement of the station, with new bus ramps to replace the facility taken by the Proposed Action ramping system. The new busway incorporated into the Proposed Action will allow a substantially improved transfer facility between the existing airport shuttle bus and the rapid transit service, consistent with the project's goals of minimizing congestion on I-90 by maximizing use of public transportation to the airport.

South Station: The 1985 FEIS/R included the design of a major bus/HOV ramp system to and from I-93 to the south and I-90 to the east. That system included a major connection along I-93 southward to Southampton Street, which was planned as a one-way facility, but reversible by time of day. The Proposed Action incorporates an improved series of HOV connections, including the use of a two-way connection between the I-93/I-90 Interchange and the I-93/Massachusetts Avenue interchange, eliminating the safety problem associated with the reversible by time of day operation. The Proposed Action incorporates an HOV system which provides access to and from South Station, as proposed in 1985. The Proposed Action has been designed to be consistent with a possible future decision by the Department to build an HOV lane on the Southeast Expressway from Braintree.

1.5 REGULATORY FRAMEWORK AND COMPLIANCE

Approval of the 1985 FEIS/R was one of several procedural steps necessary prior to construction of the Artery/Tunnel Project. Many of the activities to be undertaken in implementing the project are subject to Federal and State regulatory jurisdiction. (Because the Massachusetts Department of Public Works is a State agency, it is not legally subject to ordinances or local permits except to the extent that the Massachusetts Legislature has specifically determined it to be appropriate for State agencies to submit to local jurisdiction, such as in the case of certain environmental permitting processes.) Figure 1.5 summarizes by agency jurisdiction the potential Federal and State permits required for the project. A more detailed discussion can be found in the appendix on Permits and Approvals.

Major permitting requirements are for activities which potentially affect water quality and resources and which involve excavation and materials disposal. Many of these permits are interdependent, one being a prerequisite for another, and therefore require close coordination with and among involved agencies, and careful planning to provide that adequate time is allowed for application sequencing, processing, and agency determinations.

Work Items	Corps of Engineers	Coast Guard	Environmental Protection Agency	Federal Aviation Administration	EOEA: Coastal Zone Management Office	EOEA: Environmental Policy Act Unit	DEP: Division of Water Pollution Control	DEP: Division of Water Pollution Control	DEP: Division of Water Pollution Control	DEP: Division of Water Pollution Control	DEP: Division of Water Pollution Control	DEP: Division of Air Quality Control	DEP: Bureau of Waste Site Clean Up	DEP: Division of Wetlands & Waterways	DEP: Division of Solid Waste Management	MDC	Boston & Cambridge Conservation Commissions
Administering Agency	Federal				State												Local
Permit/Approval	Sections 10, 404 & 103 Permits	Bridge Permits (Section 9)	NPDES Permits	Certificate of No Hazard	CZM Consistency Concurrence	MEPA Certificate on Projectwide SEIS/R	Surface Water Discharge Permits	Groundwater Discharge Permit	Underground Injection Control	Water Quality Certifications	Sewer Extension & Connection Permits	Plan Approval	Mass. Contingency Plan Approved	Chapter 91 Licenses	Permit and Plan Approval	Charles River Basin Approval	Wetlands Protection Order**
Confined Marine Disposal Site	●		●	●	●	●	●			●				●	●		●
Mass. Bay Disposal Site (Dredged Materials)	●				●	●											
Dewatering Activities*			●			●	●	○	○		●						○
Barge Loading Facilities*	●		●		●	●	●			●				●			●
Fort Point Channel Crossings (FPC)	●	●			●	●				●				●			●
Casting Basin	○				●	●				●				●			●
Gillette Cooling Water Modifications	●		●		●	●	●			●				●			●
Remove Existing FPC Bridges	●	○			●	●				●							●
Third Harbor Tunnel	●				●	●				●	●			●			●
Bridges Over Charles River		●			●	●				●						●	●
Ventilation Structures	●			●	●	●				●	●		○	○			●
Concrete Batch Plants*						●	○	○		○	●	●					
Utility Relocations					●	●					●		○	○			●
Stormwater Outfall	●		●		●	●	●			●	●			●			●
Administration Building					●	●					●						
Depressed Roadway						●							○	○			

○ - Permit requirements to be determined as design details are finalized.

● - Required

Blank - Not Applicable or Not Required

* Temporary Activities

MDC - Metropolitan District Commission

FPC - Fort Point Channel

DEP - Department of Environmental Protection

EOEA - Executive Office of Environmental Affairs

** Local conservation commissions administer State law

FIGURE 1.5

Potential State And Federal Permits And Approvals

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

The Artery/Tunnel Project's objective is to provide information in the SEIS/R and its supporting documents to facilitate decision-making by permit agencies on the Proposed Action. The SEIS/R, including its appendices and related technical support documents, although not intended to serve as actual permit applications, present data and information to support environmental and construction permit applications. Continuing discussions with agencies, particularly through the Interagency Coordinating Committee and one-on-one meetings, have guided the extensive field work and impact analyses undertaken for this SEIS/R. In addition, the comprehensive information collected in the SEIS/R will facilitate coordination of reviews by agencies with overlapping jurisdiction, especially in the water resources area.

1.6 ORGANIZATION OF THE SEIS/R

The SEIS/R is organized into three parts. Part I, in two volumes, following this Introduction, provides an updated description and environmental impact analysis of the current Artery/Tunnel Project design, referred to as the Proposed Action.

In the third volume, Part II assesses changes or additions to specific project components for which several alternative design approaches have been considered since 1985, and compares the environmental impacts of the respective alternative approaches for each of these four elements. The four alternatives analyses presented are: (1) the Area North of Causeway Street (Charles River Crossing), (2) the South Boston Bypass Road, (3) I-90 Toll Plaza Locations, and (4) Materials Disposal Program Options. Part II also summarizes lesser design refinements made since 1985 or currently under consideration.

Part III of the SEIS/R, also in the third volume, contains an updated Section 4(f) Evaluation, which reviews the impacts of project changes and design modifications on public parks and historic and archaeological resources.

Appendices are a part of the SEIS/R and are published in separate volumes (see list in the Table of Contents). Any of the separate appendix volumes is available to the public on request.

Chapter 2 – Proposed Action

Chapter 2
PROPOSED ACTION

2.1 OVERVIEW

The Central Artery (I-93)/Third Harbor Tunnel (I-90) Project is referred to as the Proposed Action in this SEIS/R.

The Proposed Action is based on the Preferred Alternative (5A Modified) described in the FEIS/R. This chapter describes the Proposed Action; for more detailed technical information and drawings, refer to the Supportive Engineering Report (SER), printed as an appendix to this SEIS/R.

The Proposed Action, shown in Figure 2.1, consists of the following major elements:

- Construction of a widened, mostly underground Interstate 93 (I-93) from just north of the Central Artery/North Area interchange (I-93/Route 1) in Charlestown to just south of the Massachusetts Avenue interchange. I-93 is referred to as the Central Artery north of Kneeland Street, and as the Southeast Expressway south of Kneeland Street.

- Construction of an I-90 extension via a Seaport Access Road and Third Harbor Tunnel to Logan Airport in East Boston, with a connection to Route 1A. The I-90 extension will begin at the present terminus of the Massachusetts Turnpike (I-90) at the Southeast Expressway (I-93) and proceed eastward, mainly in tunnel, through South Boston, under Boston Harbor, and into Logan Airport. A much improved and expanded high-occupancy vehicle (HOV) system will also be incorporated along I-93 and I-90 to link downtown at Kneeland Street and the proposed South Station Transportation Center (SSTC) by others, with Logan Airport and points south and west of Boston.

- Construction of an extended frontage road system parallel to I-93 both northbound and southbound from Causeway Street to just past Southampton Street. A frontage road system parallel to I-90 eastbound and westbound will also be constructed from the Albany Street Extension to the Frontage Road northbound via Marginal Road and West Broadway and Herald Street.

- Construction of a South Boston Bypass Road, most of which will be in an existing railroad right-of-way. It will connect the Southeast Expressway (I-93) directly to the Seaport Access Road (I-90) and the Commonwealth Flats area in South Boston.

Construction of these major elements will improve the existing highway system in several ways:

- The Central Artery (I-93) will be widened to eight lanes (four lanes each way with intermittent auxiliary lanes) to increase traffic capacity. The roadway geometry and weaving movements will be revised and acceleration and deceleration lanes will be added to reduce congestion and improve traffic flow. As a result, system safety will also be improved.

- o The addition of the Seaport Access Road (I-90) (six through lanes) and the Third Harbor Tunnel (four through lanes) will divert traffic away from the Central Artery by providing travellers from the west and south of Boston with a more direct connection to Logan Airport. Currently, airport and Route 1A bound traffic must pass through downtown Boston to reach the Sumner and Callahan Tunnels for access to Logan Airport and East Boston. In addition, the Seaport Access Road will increase accessibility to the South Boston seaport area.

- o The improved HOV system will provide high-occupancy vehicles with head-of-queue privileges throughout most of the project.

- o The extended frontage road system will provide increased accessibility to local streets along the Central Artery and Southeast Expressway.

- o Construction of the Bypass Road will provide commercial vehicles, such as trucks, and HOVs with a new route through South Boston, which avoids local streets. In addition, it will provide a surface route for trucks carrying fuel and other hazardous materials which would not be allowed in the I-90 tunnels.

In order to compare the locations of the Proposed Action roadways with the existing network and to review the corresponding number of lanes, refer to Figures 2.2 and 2.3. (Figure 2.2 shows the existing facilities. Figure 2.3 shows the proposed roadways and ramps. These drawings are not to scale and have been distorted to display the roadway network configurations, ramp connections, and number of through lanes and turning lanes.)

In keeping with the usual practice for major highway projects, revisions and refinements will continue to be made as the project moves through the preliminary engineering, final design, and construction phases (see Part II D of the SEIS/R). The design, as presented in this SEIS/R, is currently at a sufficient level of detail to assess significant environmental impacts.

2.2 PROJECT DESCRIPTION BY SUBAREA

The project has been divided into six geographical subareas, starting in the north and proceeding south, then from west to east, as shown in Figure 2.4. This section describes the project by subarea and includes figures of the proposed roadways for each. To better understand the following descriptions, it should be noted that within each subarea the proposed mainline southbound roadways are generally described from north to south, and the northbound roadways are usually described from south to north. Westbound roadways are generally described from east to west, and eastbound roadways from west to east. This type of description corresponds to the direction in which vehicles would be travelling on each of these roadways. In some cases, both northbound and southbound or eastbound and westbound roadways are described together in only one direction, rather than separately in the direction of vehicle travel. This is used when both roadways follow almost identical alignments and can be described simultaneously.

FIGURE 2.1

Proposed Action - Central Artery/Tunnel Project

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

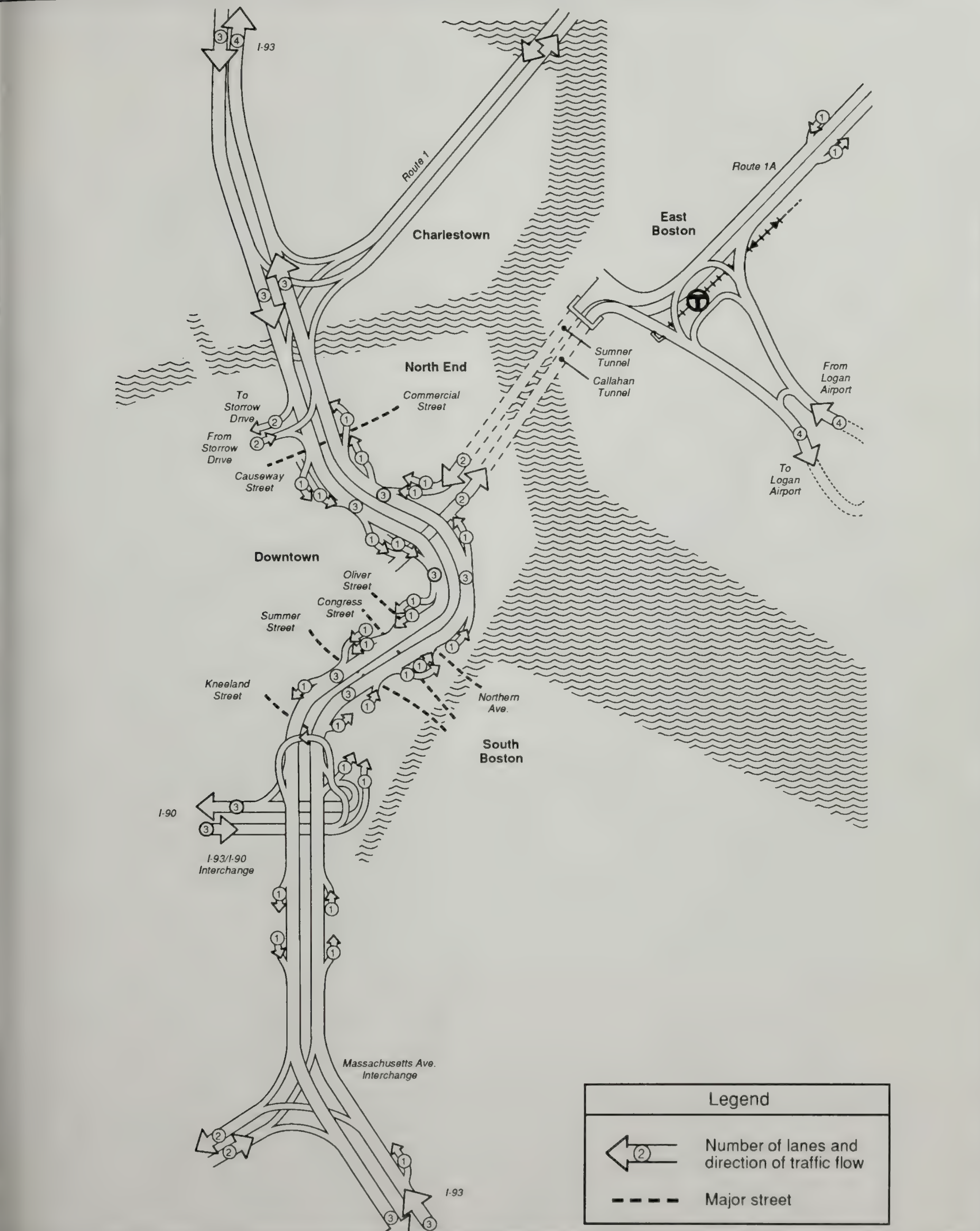


FIGURE 2.2 **Existing Facilities Diagram**

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

Not To Scale

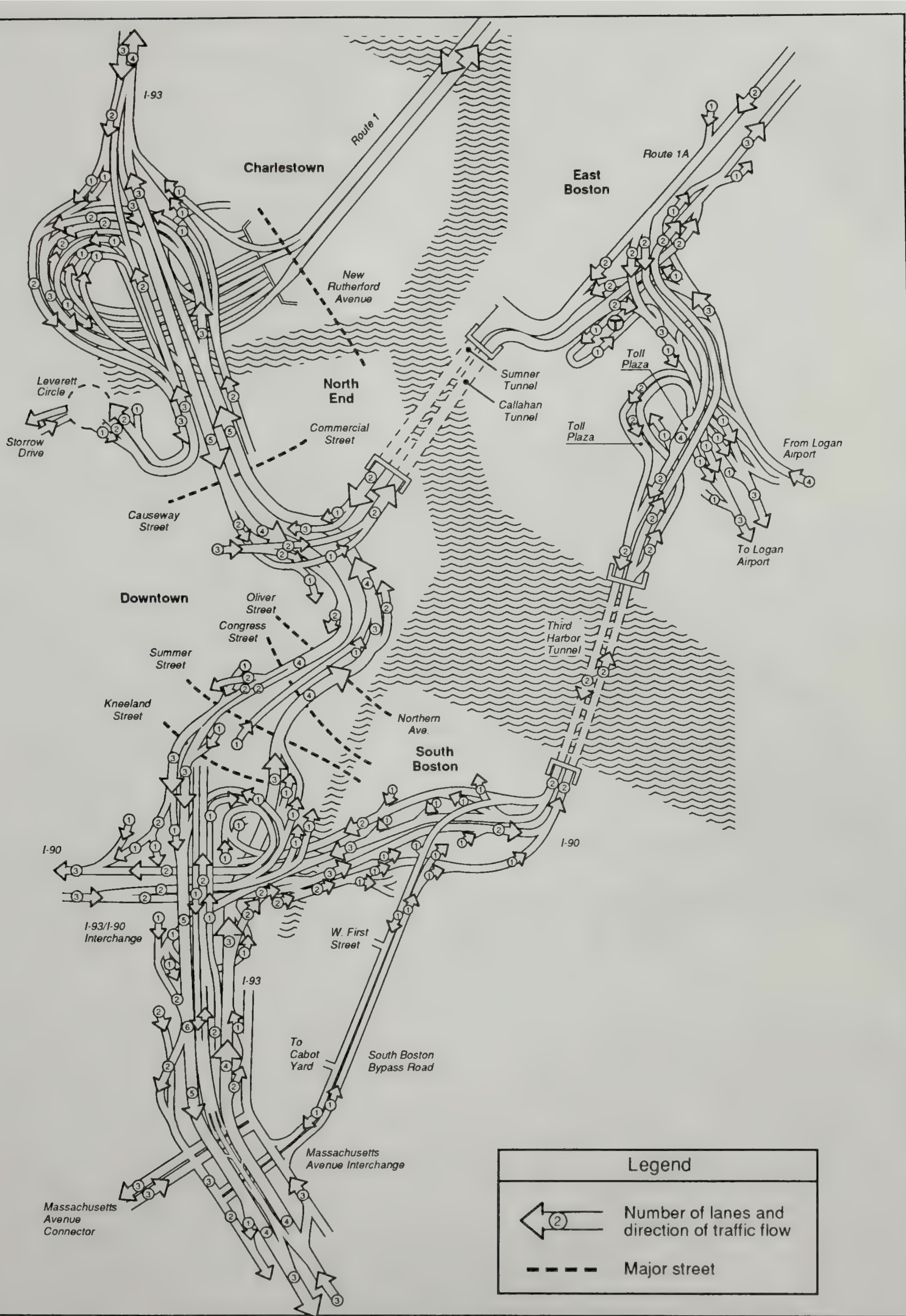


FIGURE 2.3

Proposed Facilities Diagram

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

Not To Scale

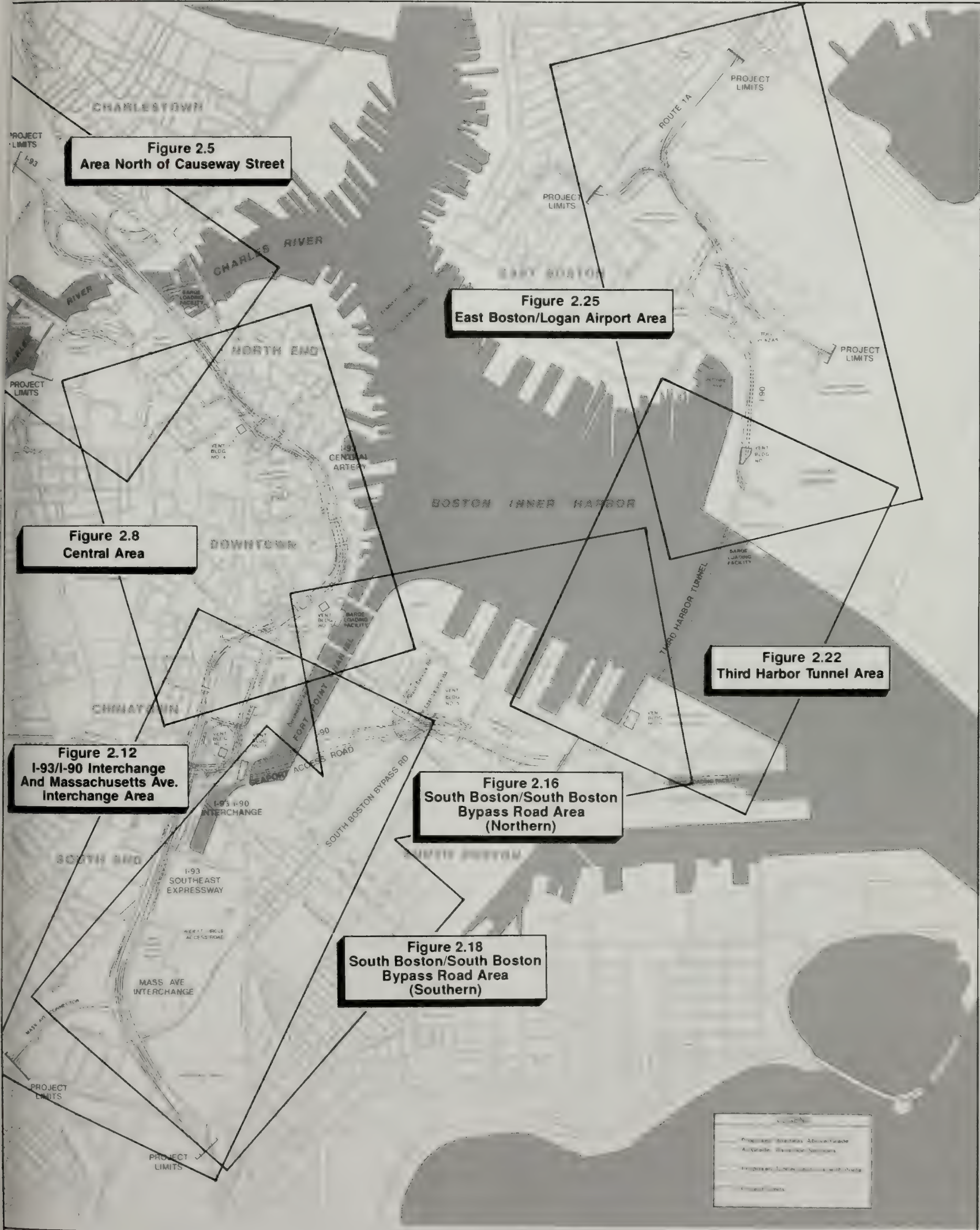


FIGURE 2.4

Project Subareas Key Plan

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

2.2.1 Area North Of Causeway Street

2.2.1(a) Proposed Action

As shown in Figure 2.5, the Proposed Action will meet the existing I-93 double-deck viaduct in Charlestown approximately 1,700 feet north of the Gilmore Bridge. At this point, the proposed I-93 northbound lanes will be directly above the southbound lanes. From here, the proposed I-93 northbound and southbound viaduct (three to four lanes each way) will proceed southward through Charlestown. As the structure approaches the Charles River, northbound and southbound traffic lanes will be side by side to pass over the Charles River on two new parallel bridges into Boston with the number of lanes increased to five in each direction. The I-93 highway structures will descend gradually into tunnels at Causeway Street.

A major new interchange will be constructed in Charlestown and Cambridge to connect I-93 northbound and southbound to points east and west. The proposed interchange will be an intricate network of viaduct structures. (See the section view in Figure 2.6 for a better understanding of these ramps.) Many of the proposed ramps will connect to existing ramps, constructed for the CANA (Central Artery North Area) project, for access to streets in City Square in Charlestown and to Route 1. (The objective of the CANA project, currently under construction in Charlestown by the Department, is to improve safety and traffic flow on the I-93/Route 1 interchange.) Other ramps will provide connections to Leverett Circle and Storrow Drive via a new Leverett Circle connector over the Charles River, west of the two proposed bridges. The ramps will connect to surface streets and pass under Leverett Circle in tunnels for connections to Storrow Drive.

Surface streets in the vicinity of Leverett Circle will be reconstructed as shown in Figure 2.5 to maintain existing traffic movements.

2.2.1(b) Comparison To Existing Facilities

The existing highway system in Charlestown consists of a three- to four-lane-wide double-deck viaduct structure with northbound lanes over southbound lanes. Most of the existing viaduct will be removed and replaced with the new elevated interchange system as part of the Proposed Action design from a point in northern Charlestown south to the Charles River.

The existing double-deck viaduct connects to a double-deck, high-level truss bridge, which crosses over the Charles River from Charlestown into downtown Boston. The truss bridge has three lanes each way. The Proposed Action will place two new parallel bridges to the west of the existing truss bridge and increase the number of lanes to a maximum of five each way. The truss bridge will be removed upon completion of the new bridges and connections.

At Causeway Street the truss bridge currently connects to the existing elevated Central Artery with three lanes each way. In comparison, the proposed parallel bridges will descend into tunnels at Causeway Street with five lanes each way.

Existing northbound and southbound I-93 lanes connect to Charlestown streets and Route 1 via elevated ramps on the north bank of the Charles River. In comparison, in the Proposed Action vehicles from northbound and southbound I-93 will connect to Charlestown streets and Route 1 via a new interchange in Charlestown.

Connections between the existing northbound and southbound I-93 and Leverett Circle and Storrow Drive are provided via a viaduct structure south of the Charles River and north of Causeway Street. In the Proposed Action, connections between northbound and southbound I-93 and Leverett Circle and Storrow Drive will be provided via a new double-deck Leverett Circle connector from the Charlestown interchange over the Charles River, immediately west of the two new I-93 Charles River bridges, connecting to the existing viaduct just north of the Boston Garden. Consequently, in the Proposed Action traffic headed to Leverett Circle and Storrow Drive from the south on I-93 will no longer have a direct connection on the south side of the river. Rather, vehicles will use the Charles River bridges to reach the Leverett Circle connector for access to Leverett Circle and Storrow Drive. Similar moves will be made by traffic in the opposite directions. The purpose of this new Leverett Circle connector is to eliminate the safety hazard caused by inadequate weaving distances in the existing system. This new connector will substantially extend the weaving distances and, thus, increase safety.

2.2.1(c) Proposed Major Traffic Movements

Figure 2.7 depicts the following major traffic movements for the Proposed Action design in the Area North of Causeway Street. The numbers identify each movement. (Refer to the SER for information on all proposed traffic movements for all project subareas.)

- o 1 - I-93 southbound
- o 2 - from I-93 southbound to Leverett Circle or Storrow Drive (via Ramps N-S and CN-S)
- o 3 - from I-93 southbound to City Square in Charlestown (via Ramps N-T, C-T, and C-L)
- o 4 - from I-93 southbound to Route 1 (via Ramps N-T and C-T)
- o 5 - I-93 northbound
- o 6 - from I-93 northbound to Leverett Circle or Storrow Drive (via Ramp CN-S)
- o 7 - from I-93 northbound to Route 1 (via Ramp C-T)

2.2.2 Central Area

2.2.2(a) Proposed Action

South of Causeway Street, the Central Artery (I-93) northbound and southbound lanes will be in tunnels, passing beneath downtown Boston, along the same general alignment as the existing elevated Central Artery (see Figure 2.8). Near Summer Street the northbound and southbound tunnels will diverge with the southbound tunnel connecting to the existing Dewey Square tunnel. The southbound tunnel portal near Kneeland Street will remain. The I-93 northbound tunnel will be constructed beneath Atlantic Avenue with the entrance portal located in the I-93/I-90 Interchange Area.

Connections between points north on I-93 and the Sumner and Callahan Tunnels, for access to the airport and East Boston, will be via underground ramps. Travellers from points west and south of the Sumner and Callahan Tunnels will be directed along the Seaport Access Road (I-90) and through the Third Harbor Tunnel to reach the airport and East Boston. Other ramps will be built to provide connections between I-93 northbound and southbound and surface streets in downtown Boston, as shown in Figure 2.8.

Surface streets within the project corridor will be rebuilt over the tunnels to complete the surface street network; although final details will be worked out during final design. (See Figure 2.9.) A surface arterial street system (frontage road system) extending from the

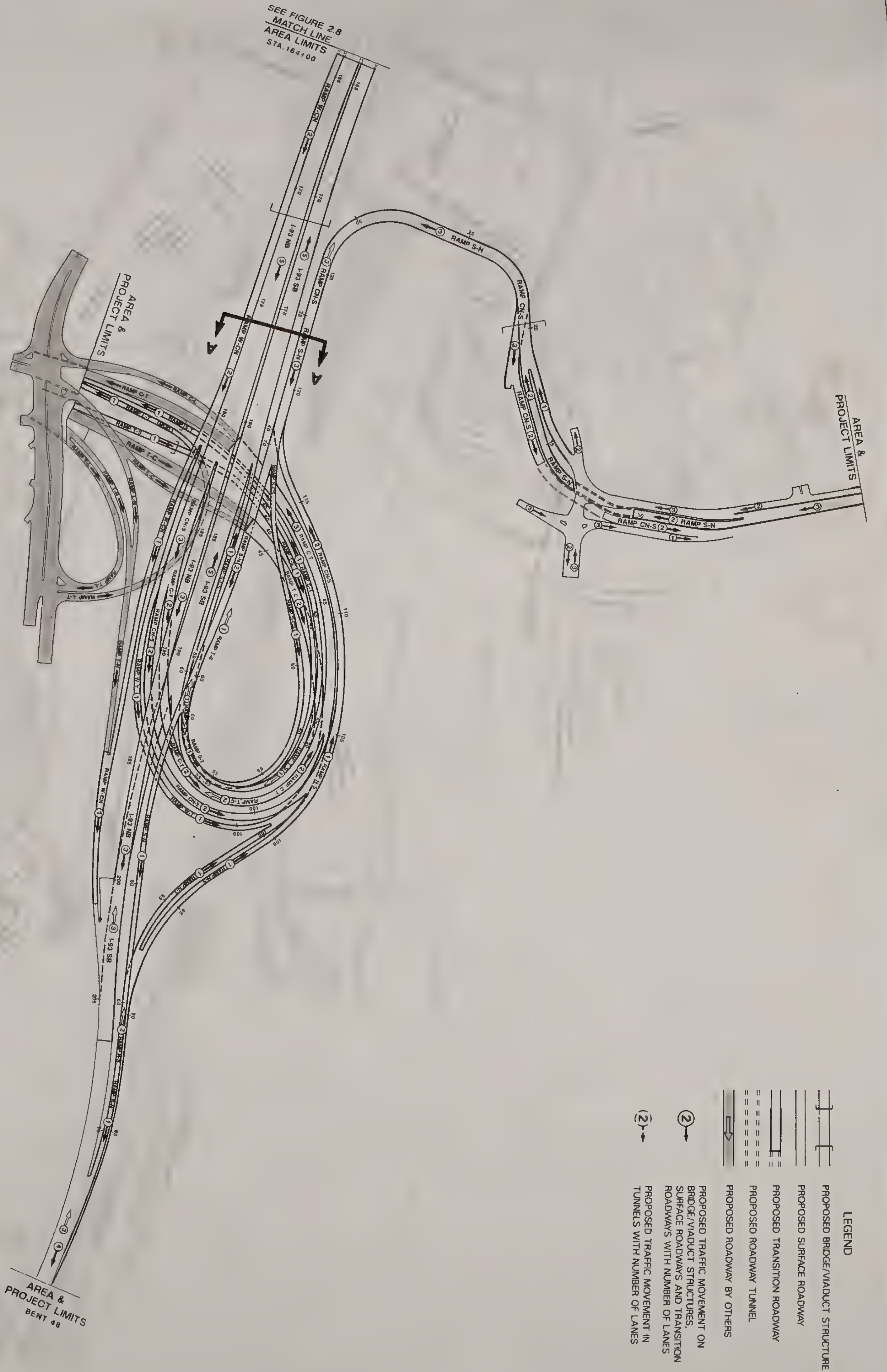
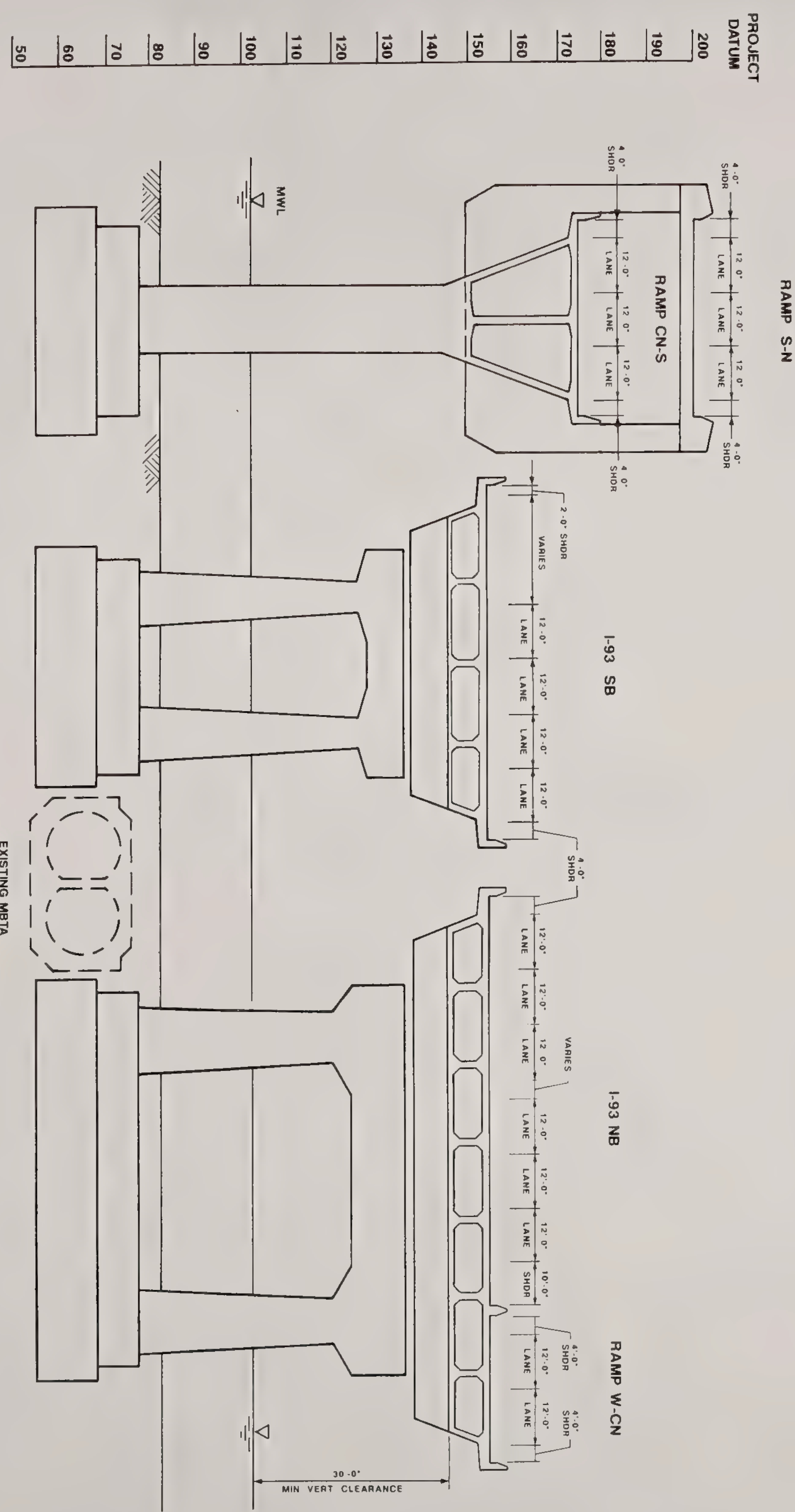


FIGURE 2.5 **Area North Of Causeway Street Alignment**

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R



SECTION A-A

Approximately 2400 Ft. South of John Gilmore Bridge

Refer to Figure 2.5 for location of section.

FIGURE 2.6 **Area North Of Causeway Street Section**

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

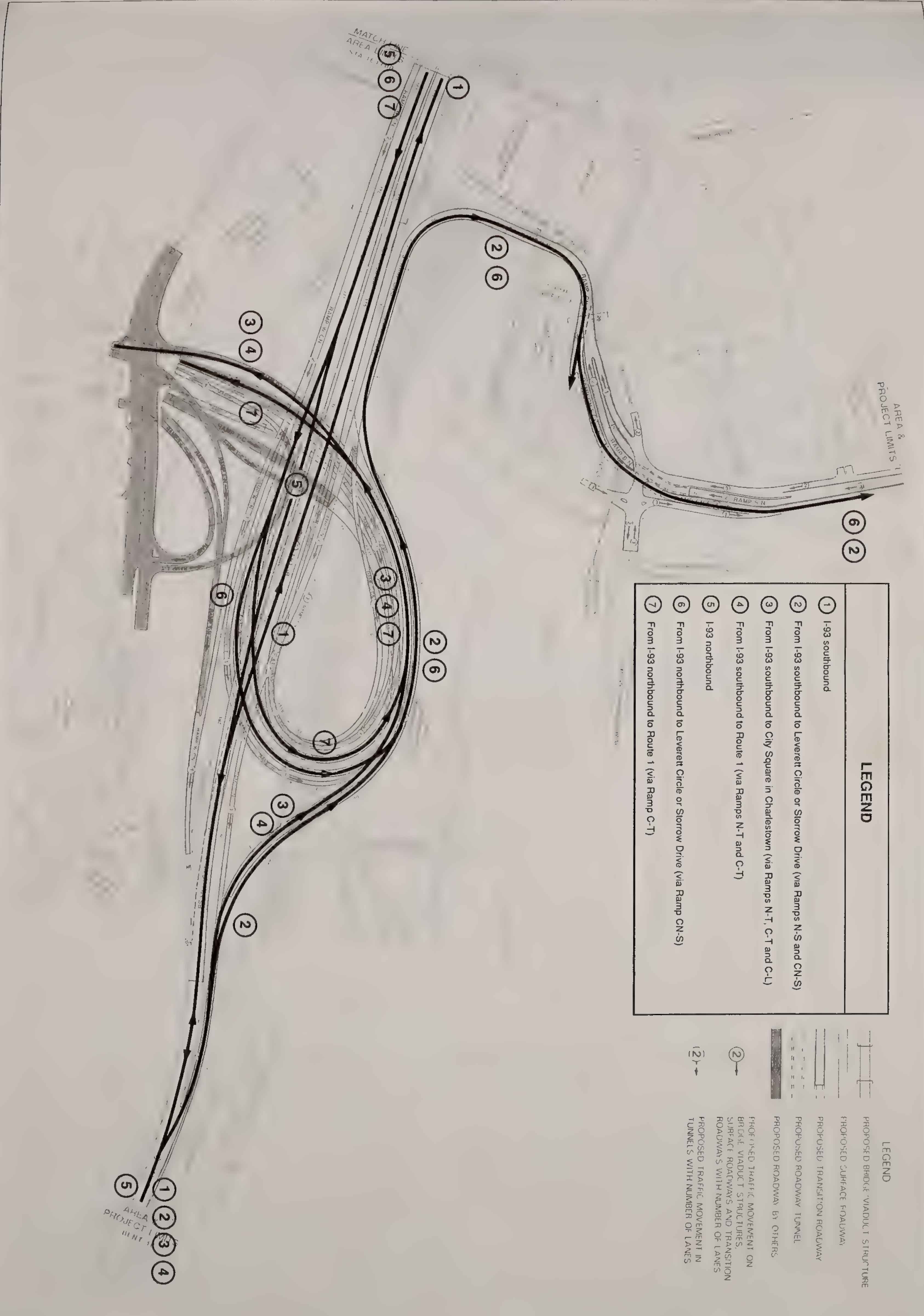


FIGURE 2.7 **Area North Of Causeway Street Major Traffic Movements**

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

FIGURE 2.8 **Central Area Alignment**

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

0 100 200 400 600
FEET

FIGURE 2.9 **Central Area Surface Street Alignment**

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

0 100 200 400 800
FEET

Central Area to the southern project limit will be constructed parallel to I-93. In the Central Area the southbound surface arterial will extend from Causeway Street in the north, along Purchase Street through the downtown area, to Kneeland Street. The northbound arterial will connect at Kneeland Street and continue along Atlantic Avenue to Causeway Street. Since on- and off-ramps will be limited to and from the Central Artery in downtown [as discussed in more detail in section 2.2.2(b)], this surface arterial system will provide vehicle access to and from all downtown locations. (Figure 2.10 provides cross section views of the roadways and structures in this area.)

2.2.2(b) Comparison With Existing Facilities

The existing Central Artery is an elevated structure in downtown Boston from north of Causeway Street to approximately Northern Avenue. At Northern Avenue the Central Artery descends into the Dewey Square tunnel. Northbound and southbound roadways are parallel to each other throughout the Central Area and have a maximum of three through lanes each way with no acceleration or deceleration lanes. The Proposed Action design will be tunnel structures throughout downtown Boston with a maximum of five lanes each way in some places. Whereas the Dewey Square tunnel presently holds both northbound and southbound lanes (three lanes each way), the Proposed Action will place northbound lanes in a new tunnel under Atlantic Avenue (three to four lanes) and all southbound lanes will use the existing Dewey Square tunnel (four southbound lanes). The Dewey Square tunnel will be rebuilt between Congress Street and Summer Street to improve roadway geometry and to accommodate a new ramp.

The number of proposed ramps to and from the Central Artery in downtown Boston will be substantially reduced, from the existing 18 ramps to 11 ramps. Reducing the number of ramps will improve traffic operations and safety on this interstate facility through downtown. Access between I-93 and all parts of downtown will be maintained through the proposed ramps and the improved surface arterial system.

Surface streets in Boston currently pass under the existing elevated Central Artery structure in the northern part of the Central Area and over the Dewey Square tunnel in the southern portion. As the proposed tunnels are completed and the existing structure is removed, surface streets will be reconstructed over the new tunnels to provide a complete surface street network in the downtown area.

2.2.2(c) Proposed Major Traffic Movements

Figure 2.11 depicts the following major traffic moves which are included in the Proposed Action design:

- 1 - I-93 southbound
- 2 - from I-93 southbound to Callahan Tunnel (via Ramp CS-CT)
- 3 - I-93 northbound
- 4 - from I-90 eastbound (Massachusetts Turnpike) to I-93 northbound (via Ramp C)
- 5 - from Sumner Tunnel to I-93 northbound (via Ramp ST-CN)
- no direct connection from I-93 northbound to Callahan Tunnel
- no direct connection from Sumner Tunnel to I-93 southbound

2.2.3 I-93/I-90 Interchange And Massachusetts Avenue Interchange Area

2.2.3(a) Proposed Action

As shown in Figure 2.12, the proposed I-93 southbound lanes will emerge from the Dewey

Square tunnel exit portal near Kneeland Street and immediately rise onto a viaduct structure (four to six lanes in most places). I-93 southbound will continue south until descending to the surface and connecting to the existing Southeast Expressway (I-93) at a point approximately 500 feet south of Southampton Street.

I-93 northbound will begin at the southern project limits where it meets the existing Southeast Expressway. From here, I-93 northbound will rise onto a viaduct structure, parallel to the southbound structure. Between West Fourth Street and West Broadway, the northbound roadway will descend into a tunnel, passing below West Broadway and I-90 eastbound and westbound, until Kneeland Street. At Kneeland Street, I-93 northbound will meet the Central Area and continue northward below Atlantic Avenue. (See Figure 2.13 for cross sections of proposed I-93 roadways.)

The easterly extension of the Massachusetts Turnpike (I-90) will begin at Harrison Avenue in the west. From here, the proposed I-90 eastbound and westbound lanes will descend into tunnel structures to pass beneath existing railroad tracks and Fort Point Channel and into South Boston. This I-90 extension into South Boston is also referred to as the Seaport Access Road (see Figure 2.14 for a cross section view).

In addition to the construction of I-93 and I-90, two existing interchanges will be reconstructed. The I-93/I-90 Interchange will be completely reconstructed and will consist of ramps, some of which will be in tunnel structures, which will connect I-90 and I-93 with each other as well as local surface streets and the South Station Transportation Center, currently under development by the Massachusetts Bay Transportation Authority (MBTA) as a separate project.

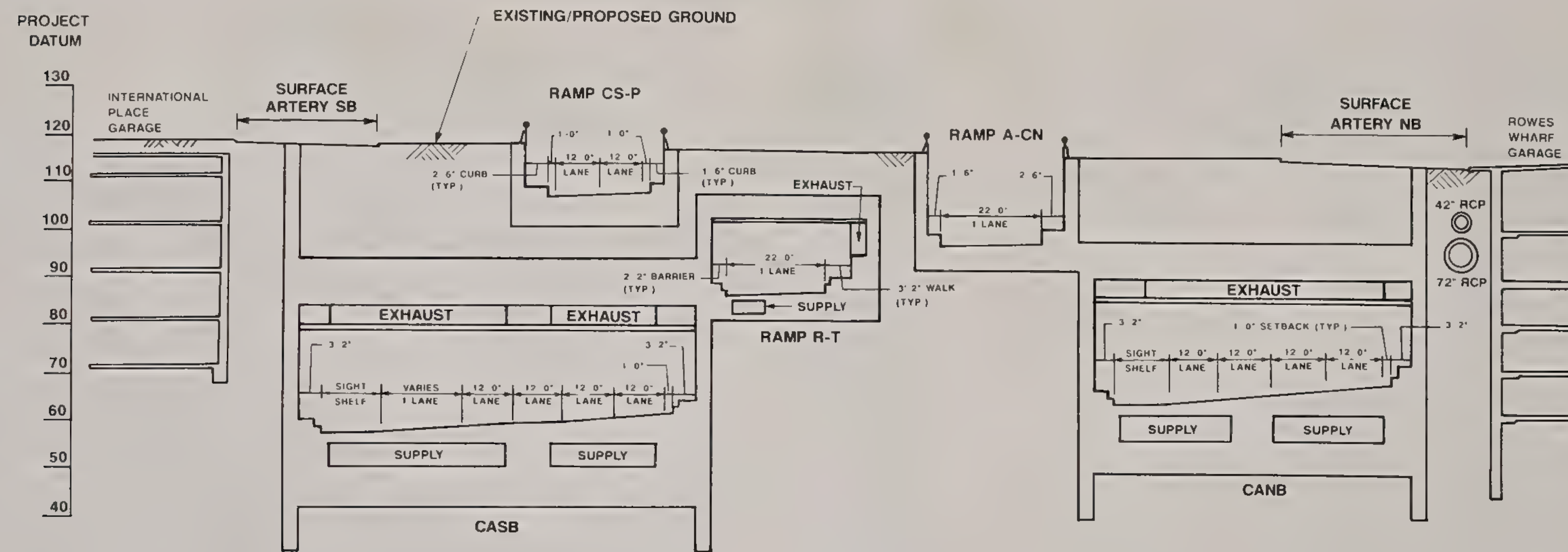
The second interchange, located further south, is referred to as the Massachusetts Avenue interchange. This reconstructed interchange will connect I-93 northbound and southbound to Massachusetts Avenue via an improved frontage road system and a new Massachusetts Avenue connector street. The interchange will be located at grade to connect the frontage road system to Massachusetts Avenue. The system also will provide connections between the proposed South Boston Bypass Road and I-93 northbound and southbound (see Section 2.4 of this chapter for a more detailed discussion of the South Boston Bypass Road).

Surface roadways, such as Kneeland Street, West Broadway, West Fourth Street, Albany Street and others, will be reconstructed as a part of the project (see Figure 2.12).

The extended frontage road system parallel to I-93 will begin in this area at Kneeland Street. The southbound Frontage Road will continue south along the Albany Street extension and further south to Boston Street. The northbound Frontage Road will begin at Boston Street and continue northward, parallel to I-93, to Kneeland Street. In addition, a street system will be formed by extending Marginal Road easterly from Albany Street to the northbound Frontage Road. This extended roadway and existing West Broadway and Herald Street will act as a frontage road system paralleling I-90.

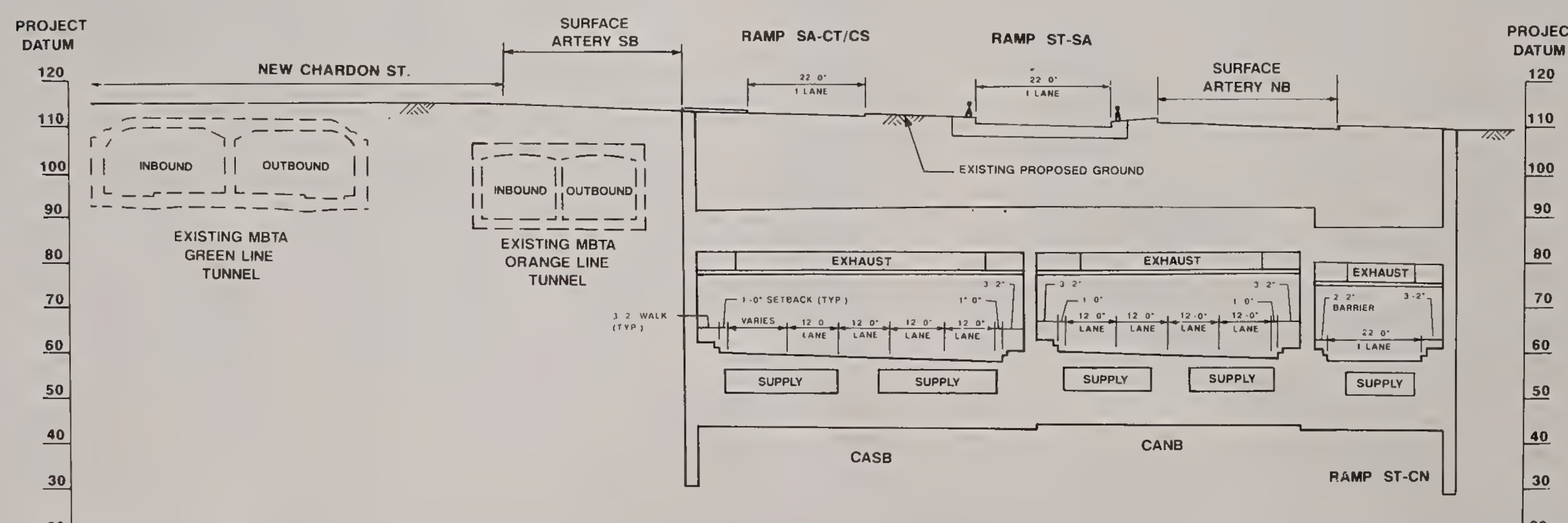
2.2.3(b) Comparison To Existing Facilities

The existing Dewey Square tunnel carries both northbound and southbound traffic. The southbound lanes emerge from the Dewey Square tunnel portal at Kneeland Street and ascend onto a viaduct structure (three lanes). The southbound viaduct then continues southward



SECTION A-A

Between International Place and Rowes Wharf



SECTION B-B

Between New Chardon and Sudbury Streets

Refer to Figure 2.8 for location of sections.

FIGURE 2.10 **Central Area Sections**

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

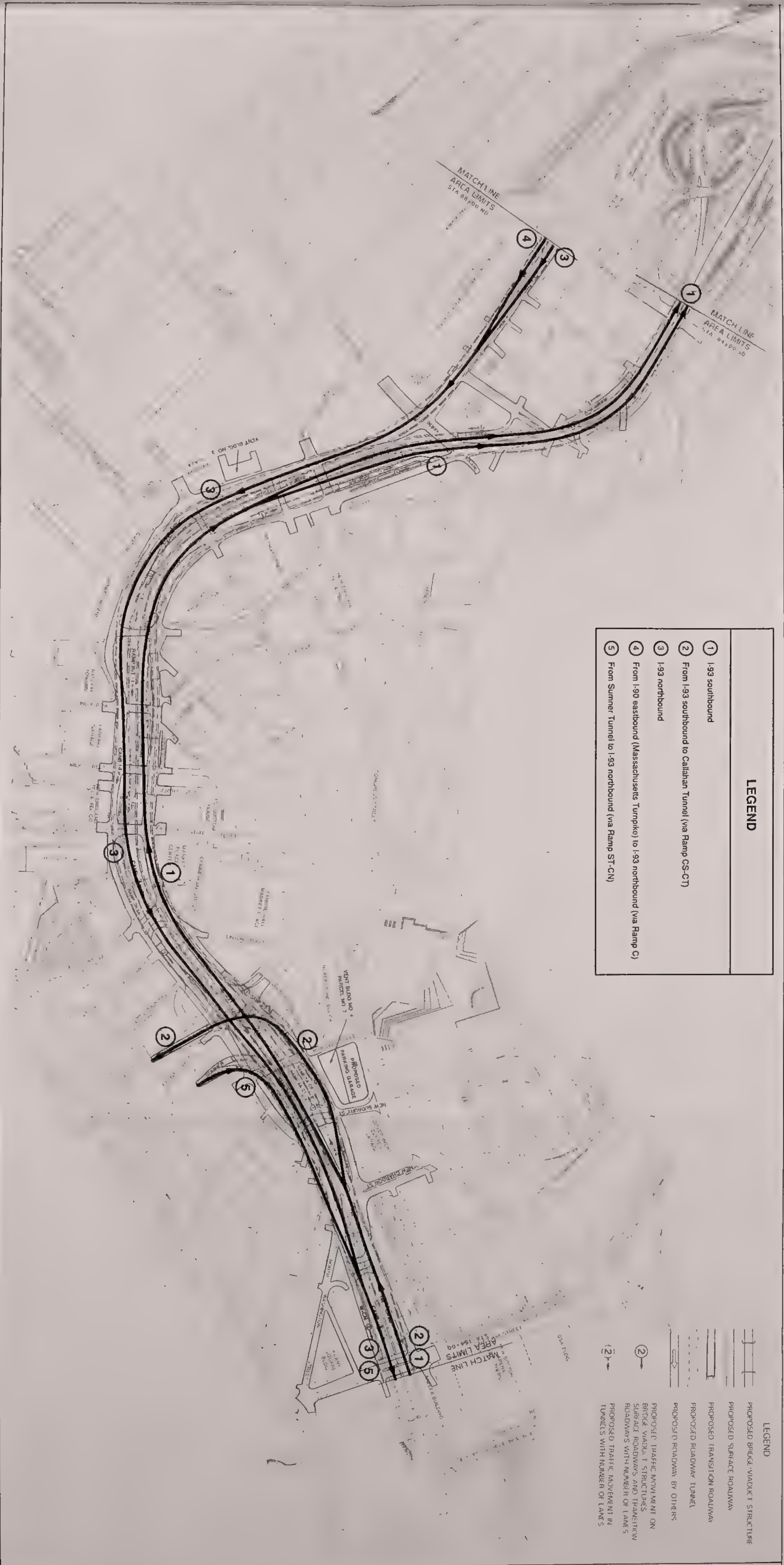


FIGURE 2.11 **Central Area Major Traffic Movements**

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

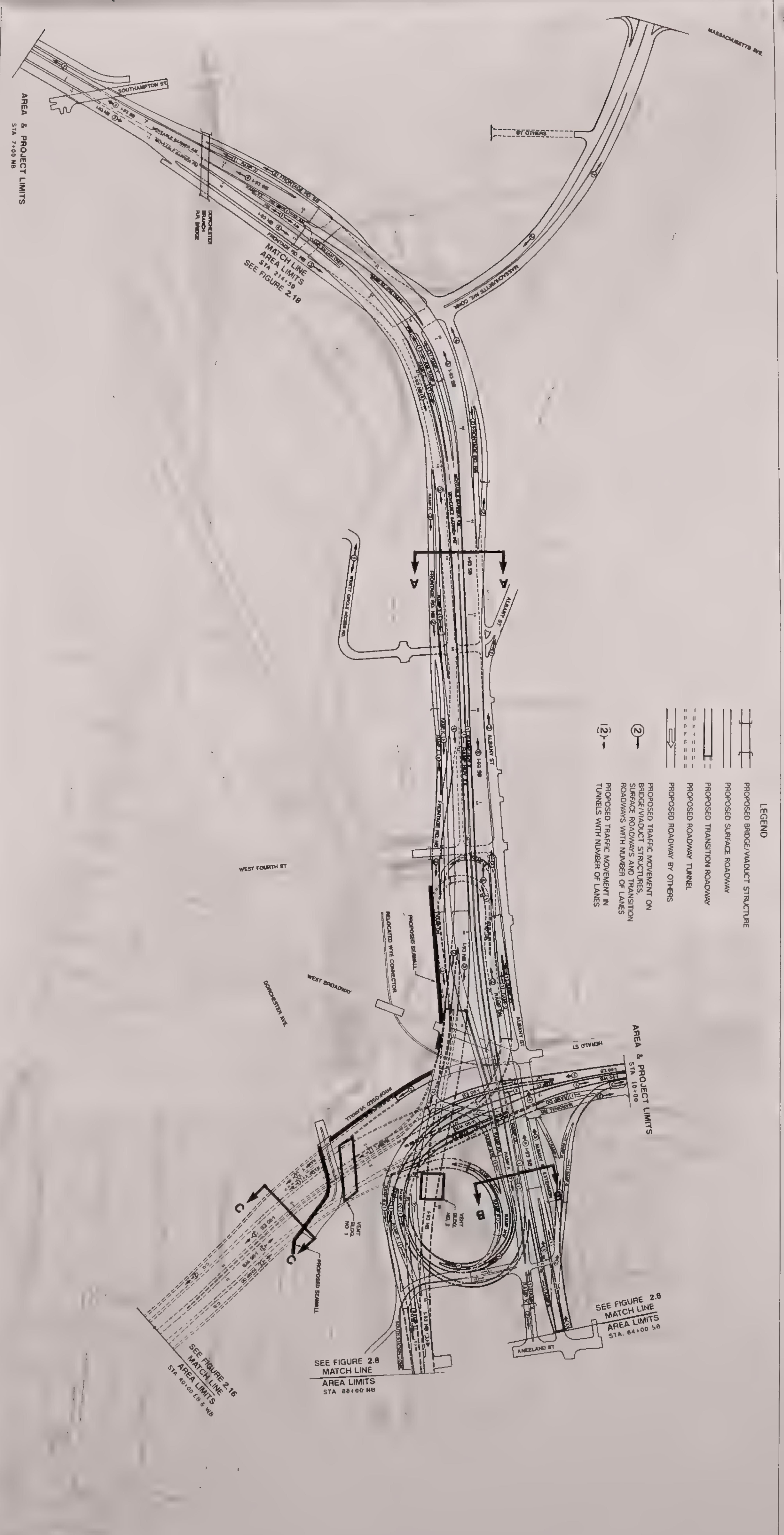
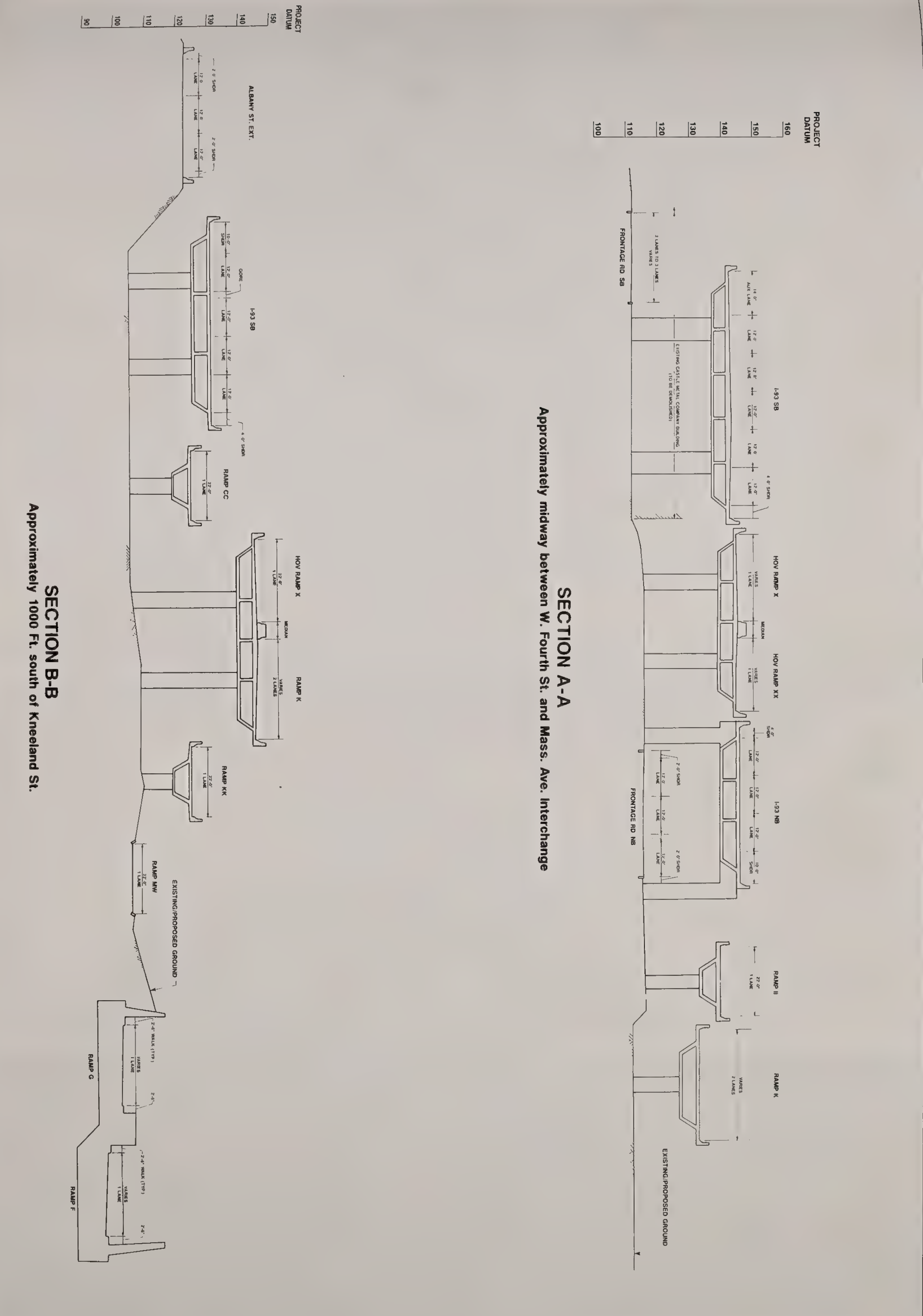


FIGURE 2.12 I-93/I-90 Interchange and Massachusetts Avenue Interchange Area Alignment

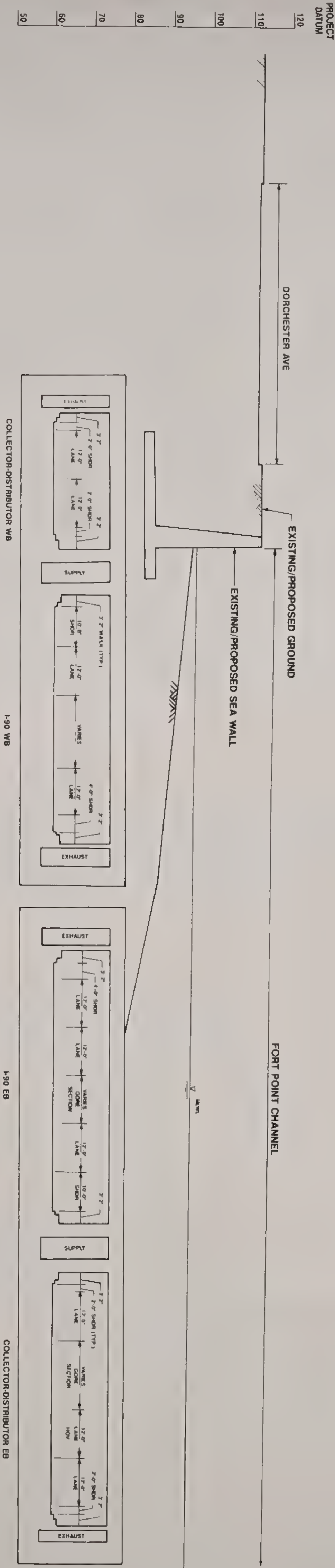
THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

0 100 200 400 800
FEET



Refer to Figure 2.12 for location of sections.

FIGURE 2.13	I-93/I-90 Interchange And Massachusetts Avenue Interchange Sections A-A And B-B	THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT SUPPLEMENTAL EIS/R



SECTION C-C
In the Fort Point Channel

Refer to Figure 2.12 for location of sections.

FIGURE
2.14

I-93/I-90 Interchange And Massachusetts Avenue Interchange Section C-C

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

until just past the Massachusetts Avenue connector where the lanes descend to surface. The existing northbound lanes (three lanes) run parallel to the southbound lanes from just south of the Massachusetts Avenue connector until entering the Dewey Square tunnel at Kneeland Street. The northbound lanes remain on the surface, however, until just before West Fourth Street, where they ascend onto a viaduct structure, parallel to the southbound viaduct.

The Proposed Action differs from the existing conditions in several ways. The Dewey Square tunnel will carry southbound traffic only by converting the existing northbound barrel into southbound lanes. The northbound lanes will be located in a new tunnel which will pass below West Broadway and I-90 and continue northward beneath Atlantic Avenue. These changes will increase traffic capacity.

2.2.3(c) Proposed Major Traffic Movements
Figure 2.15 depicts the following major traffic movements included as part of the Proposed Action:

- o 1 - I-93 southbound
- o 2 - from I-93 southbound to I-90 westbound (via Ramp H)
- o 3 - from I-93 southbound to Massachusetts Avenue (via Frontage Road southbound)
- o 4 - I-93 northbound
- o 5 - from I-93 northbound to Massachusetts Avenue (via Frontage Road northbound)
- o 6 - from I-93 northbound to I-90 westbound (via Frontage Road northbound, Ramp K, and Ramp KK)
- o 7 - from I-93 northbound to I-90 eastbound (via Ramp L)
- o 8 - I-90 eastbound
- o 9 - I-90 eastbound to I-93 southbound (via Ramp CC)
- o 10 - from I-90 eastbound to I-93 northbound (via Ramp CC to Ramp C)
- o 11 - I-90 westbound
- o 12 - from I-90 westbound to I-93 southbound (via Ramp D)
- o 13 - from I-90 westbound to I-93 northbound (via Ramp DN)
- o note: there is no direct connection from I-93 southbound to I-90 eastbound

2.2.4 South Boston/South Boston Bypass Road Area

2.2.4(a) Proposed Action
From the east side of Fort Point Channel, where the South Boston area begins, the I-90 Seaport Access Road eastbound and westbound lanes will continue in a northeasterly direction, passing beneath surface streets, such as A Street and Summer Street in South Boston (see Figure 2.16). I-90 will pass beneath Fid Kennedy Avenue and connect to the Third Harbor Tunnel at the edge of Boston Harbor. Eastbound and westbound roadways will be in tunnels throughout most of South Boston, except for an area between the Ramp Street Extension and the relocated Massport Haul Road. In this area, the roadways will be open and depressed. Eastbound and westbound roadways will vary from two to three lanes each way.

Ramps to and from local streets in South Boston will be provided for both the eastbound and westbound movements, as well as connections to the South Boston Bypass Road (see Figure 2.17 for cross section views in this area).

At its north end, the South Boston Bypass Road will connect to the Seaport Access Road (I-90) and the relocated Massport Haul Road near Viaduct and Summer Streets (see

Figure 2.16). It will continue southward as a two-way surface road (one lane each way) along the existing railroad open depressed cut and will incorporate the South Boston Haul Road. It will pass beneath eight surface street bridges until it reaches the Cabot Yard area near Dorchester Avenue. From here the Bypass Road will ascend onto a viaduct structure to pass over existing railroad and rapid transit tracks. It will then descend to the surface to connect to the Southeast Expressway (I-93) via the frontage road system (see Figure 2.18). (Figure 2.19 represents cross-sectional views of the Bypass Road.) The Bypass Road will be constructed to divert trucks, including vehicles carrying inflammable materials that are not allowed in tunnels, and HOVs away from South Boston streets and the I-93/I-90 Interchange. It will provide a direct connection for those commercial and high-occupancy vehicles desiring access to South Boston or Logan Airport. The Bypass Road will not be open to general traffic.

There will be a midway entry and exit point on the Bypass Road in the vicinity of West First Street on the west side. A limited-access driveway will be provided to the MBTA Cabot Yard facility near Dorchester Avenue for empty MBTA buses headed to and from their service routes. Eastside exits to Cypher Street or West First Street are not proposed because traffic would be required to cross railroad tracks at grade.

Streets which pass over the proposed I-90 tunnels, such as A Street, Summer Street, Viaduct Street, Northern Avenue, and Fid Kennedy Avenue, will be reconstructed in approximately their same locations as part of the project (see Figure 2.16).

2.2.4(b) Comparison To Existing Facilities

Currently, a major highway does not exist in South Boston. The Seaport Access Road, an easterly extension of I-90 through South Boston, will provide an entirely new highway system for travellers between points west and south of Boston and Logan Airport and Route 1A.

Traffic in South Boston now consists of a higher than normal percentage of trucks for central Boston neighborhoods. Construction of the South Boston Bypass Road will divert much of this truck traffic away from South Boston streets.

2.2.4(c) Proposed Major Traffic Movements

Figures 2.20 and 2.21 show the locations of the following major traffic movements included in the Proposed Action:

- o 1 - I-90 eastbound
- o 2 - from I-90 eastbound to Congress Street and Northern Avenue (via Ramp C)
- o 3 - I-90 westbound
- o 4 - from I-90 westbound to South Boston Bypass Road (via Ramp J)
- o 5 - from the South Boston Bypass Road northbound to I-90 eastbound (via Ramp L)
- o 6 - South Boston Bypass Road northbound and southbound

2.2.5 Third Harbor Tunnel Area

2.2.5(a) Proposed Action

The Third Harbor Tunnel will connect to the I-90 Seaport Access Road under the Subaru Terminal in South Boston (see Figure 2.22). It will proceed northeasterly, two lanes each way, under Boston Harbor until connecting to I-90 tunnels in East Boston in the Bird Island

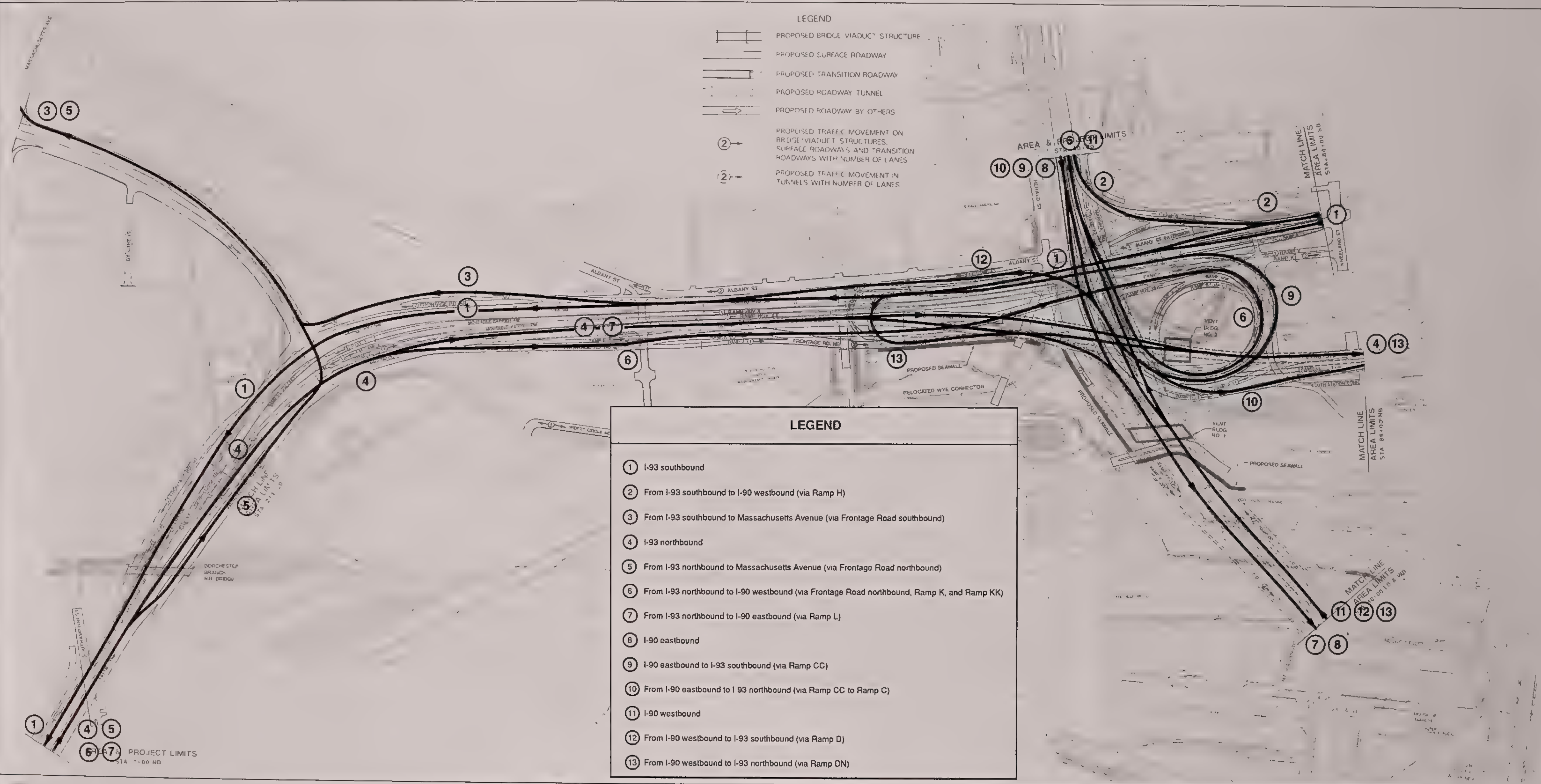


FIGURE 2.15

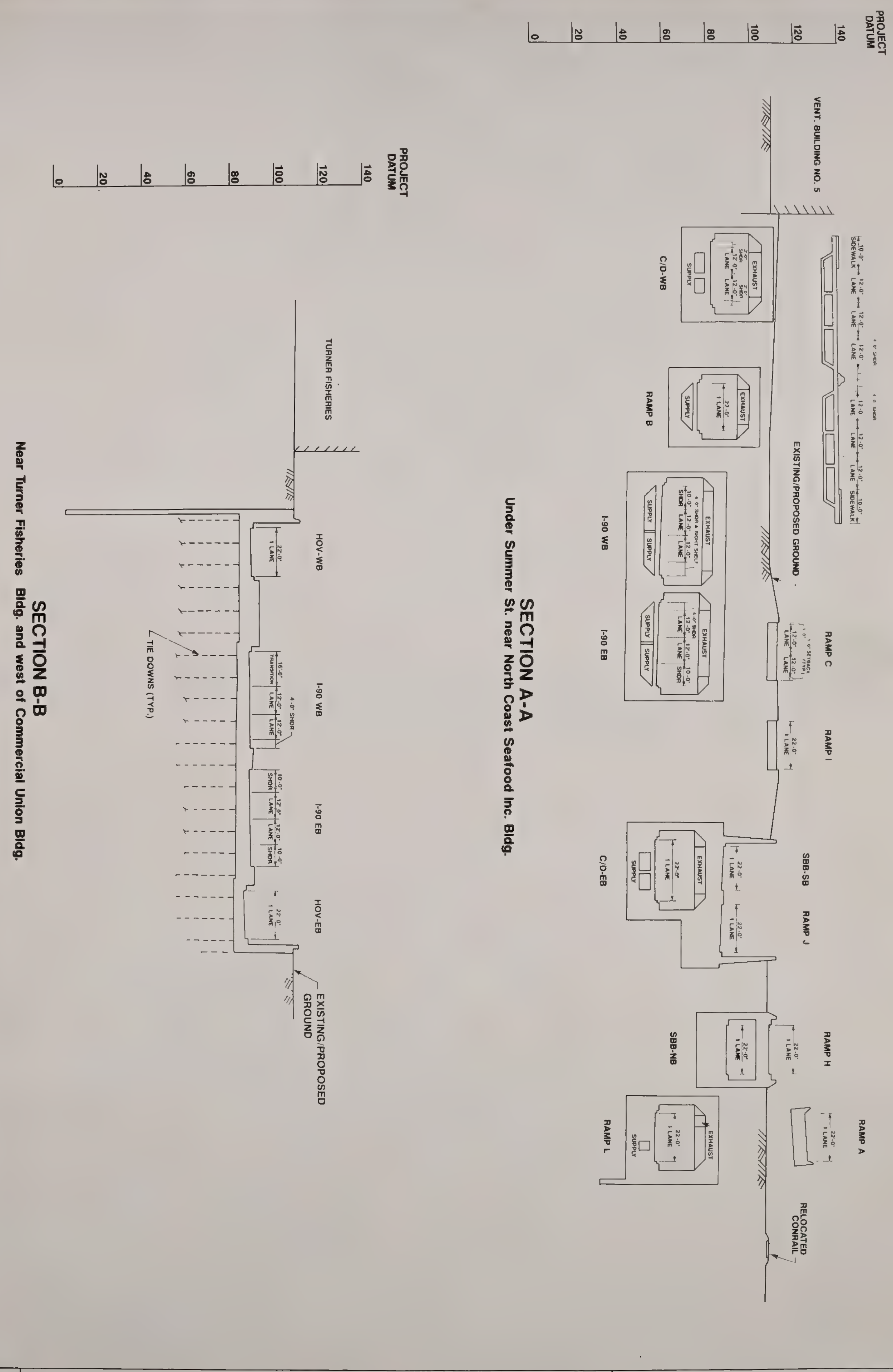
I-93/I-90 Interchange And Massachusetts Avenue Interchange Area Major Traffic Movements

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

0 100 200 400 800
FEET

FIGURE 2.16 **South Boston/South Boston Bypass Road Area Alignment (Northern Area)**

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R



Refer to Figure 2.16 for location of sections.

FIGURE 2.17

South Boston/South Boston Bypass Road Area Sections A-A And B-B (Northern Area)

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

FIGURE 2.18

South Boston/South Boston Bypass Road Area Alignment (Southern Area)

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

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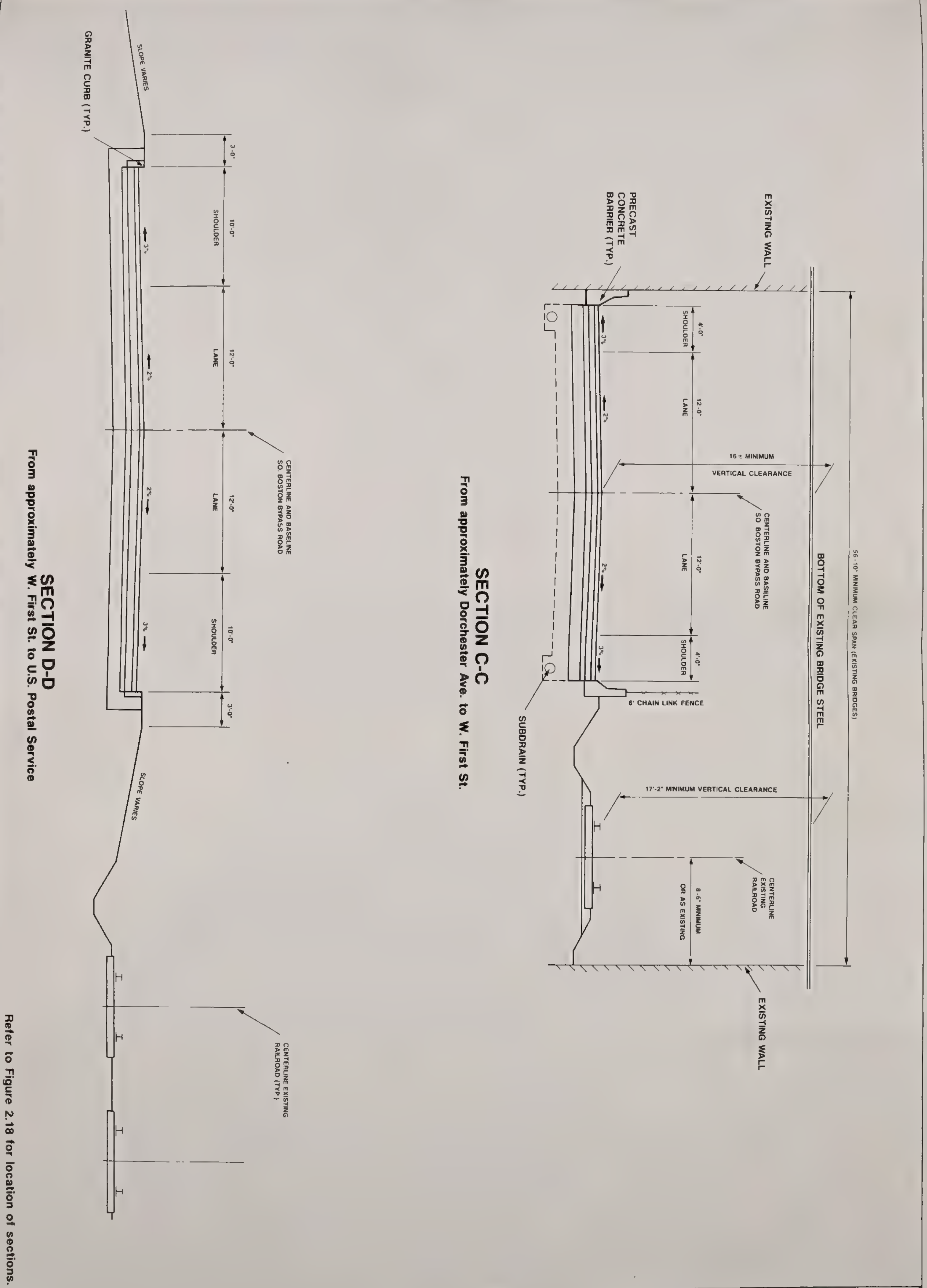

Refer to Figure 2.18 for location of sections.

FIGURE 2.19 **South Boston/South Boston Bypass Road Area Sections C-C And D-D (Southern Area)**

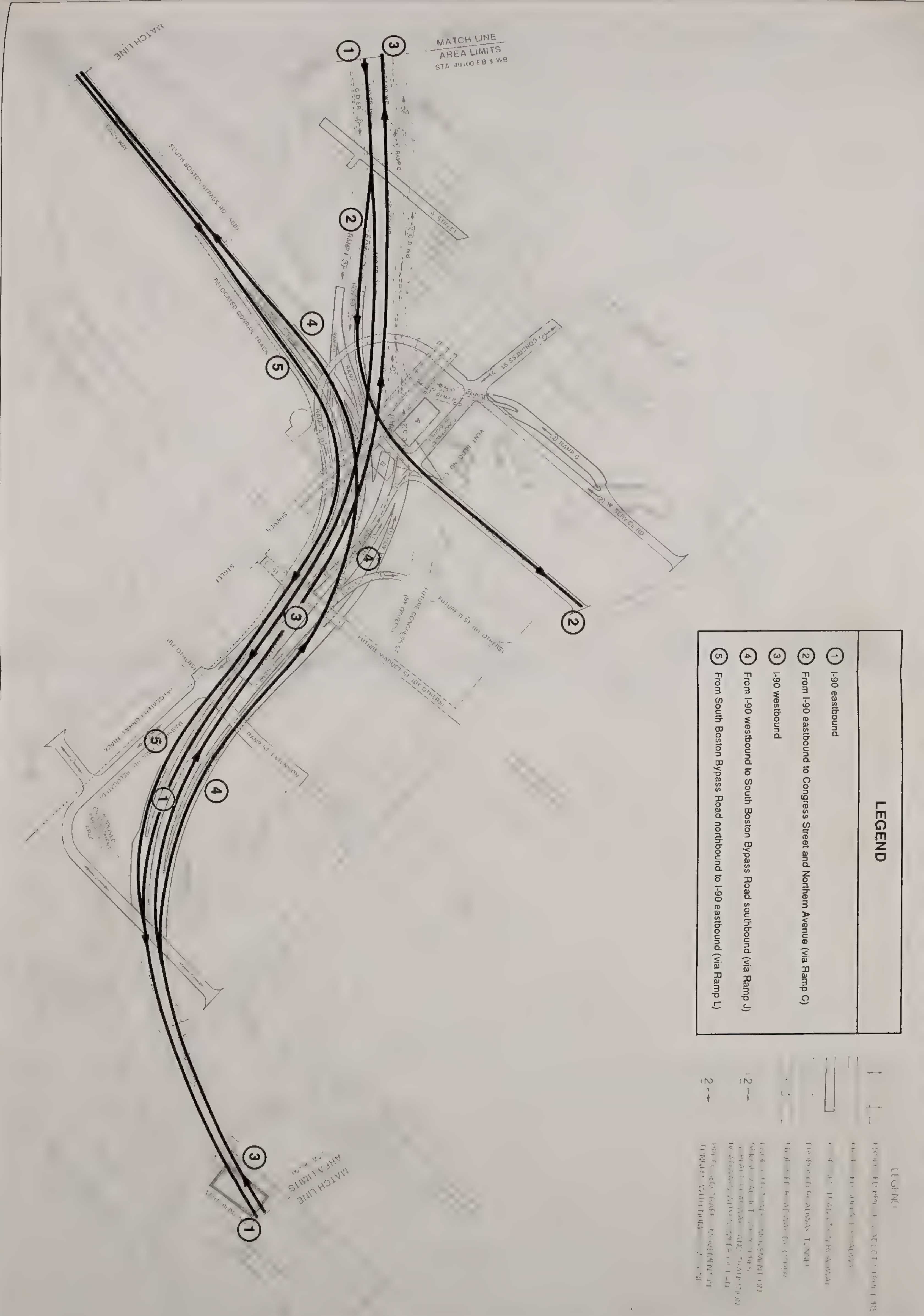

FIGURE 2.20

South Boston/South Boston Bypass Road Area Major Traffic Movements (Northern Area)

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

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FIGURE 2.21 **South Boston/South Boston Bypass Road Area Major Traffic Movements (Southern Area)**

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

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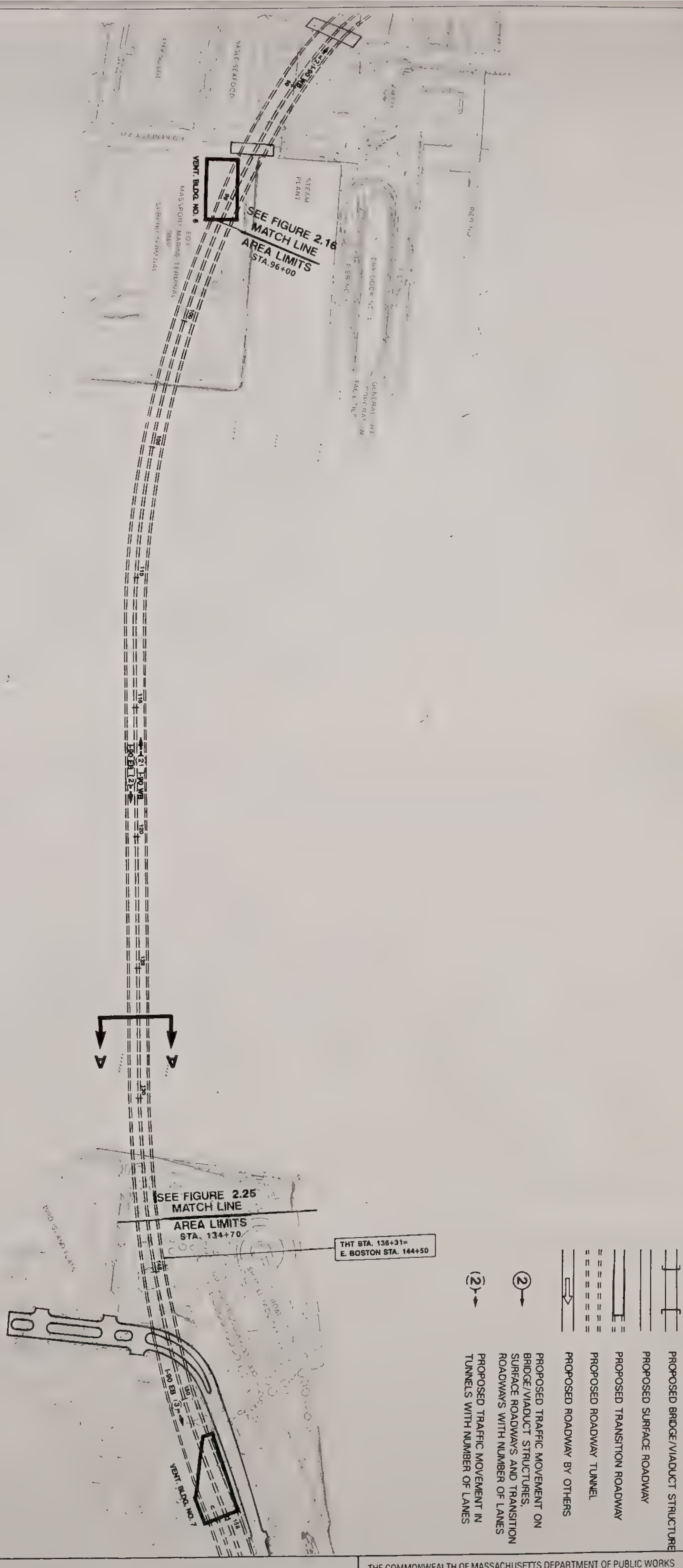


FIGURE 2.22 **Third Harbor Tunnel Area Alignment**

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

Flats area. (See Figure 2.23 for a typical cross section view.) Both eastbound and westbound traffic volumes will be metered at the tunnel portals during periods of congestion.

2.2.5(b) Comparison To Existing Facilities
No tunnel exists in this area now. As stated previously, construction of the Third Harbor Tunnel will provide travellers from west and south of Boston with a new connection to Logan Airport and Route 1A, and thus, will increase cross-harbor capacity.

2.2.5(c) Proposed Major Traffic Movements
Figure 2.24 shows the following major traffic movements as part of the Proposed Action design for the Third Harbor Tunnel:

- o 1 - I-90 eastbound
- o 2 - I-90 westbound

2.2.6 East Boston/Logan Airport Area

2.2.6(a) Proposed Action
From the Third Harbor Tunnel, the I-90 eastbound and westbound lanes (two lanes each way) will continue northward in tunnels, passing below Massport property, until emerging through portals just north of the Eastern Airlines Reservations Center (see Figure 2.25). Here, an interchange will be constructed to provide connections between I-90 and the airport terminals, as well as local streets and airport service roads in the area. The toll collection facilities for the Third Harbor Tunnel will be located in this interchange area on the airport egress roadways and I-90 westbound. I-90 eastbound and westbound will continue northward from the interchange area on viaducts over Massport property for connections to Route 1A.

As a part of the project, a segment of Route 1A will be reconstructed from the west end of Bremen Street to approximately Neptune Road. This improvement will include new connections between Route 1A and I-90 eastbound and westbound, airport access and egress roads, and local streets in East Boston. Traffic entering onto Route 1A northbound from the Airport Egress Road will not be able to exit onto Neptune Road.

Airport access and egress roads will be rebuilt as a part of the project, as well as local streets, where necessary, to maintain service. (Figure 2.26 shows cross section views of the proposed roadways in this area.) All proposed roadways will be designed and constructed to be compatible with proposed Massport and MBTA improvements. Improvements to the MBTA's Airport Blue Line station will be made as part of the Proposed Action.

2.2.6(b) Comparison To Existing Facilities
Currently most traffic enters and exits East Boston through the Sumner and Callahan Tunnels or along Route 1A. The access road to the airport from Route 1A currently passes southwest of the East Boston Memorial Stadium Park. Traffic leaving the airport follows an existing egress road which passes in front of the Hilton Hotel to the northeast of the park. Traffic then ascends onto viaducts to connect to Route 1A. The proposed access and egress roads between Route 1A and the airport will be relocated so that the Airport Access Road passes to the northeast of the park alongside a new egress road. Upon completion of the new access

and egress roadways, the existing access road will be removed allowing for potential expansion of the park.

As stated previously, the extension of I-90 through the Third Harbor Tunnel and into East Boston will provide new access and egress to and from Logan Airport and Route 1A.

2.2.6(c) Proposed Traffic Movements
Figure 2.27 depicts the following major traffic movements in the Proposed Action design:

- o 1 - I-90 eastbound to Route 1A northbound
- o 2 - I-90 eastbound to Logan Airport (via Ramp T-A/D)
- o 3 - I-90 westbound (from Route 1A southbound)
- o 4 - Airport Egress to I-90 westbound (via Ramp E-T)
- o 5 - Airport Egress to Route 1A southbound (via Ramp E-1AS)
- o 6 - Airport Egress to Route 1A northbound (via Ramp E-1AN)
- o 7 - Route 1A northbound
- o 8 - Route 1A southbound
- o note: there is no direct connection between I-90 eastbound and Route 1A southbound

2.3 COMPARISON OF THE PROPOSED ACTION TO THE FEIS/R PREFERRED ALTERNATIVE

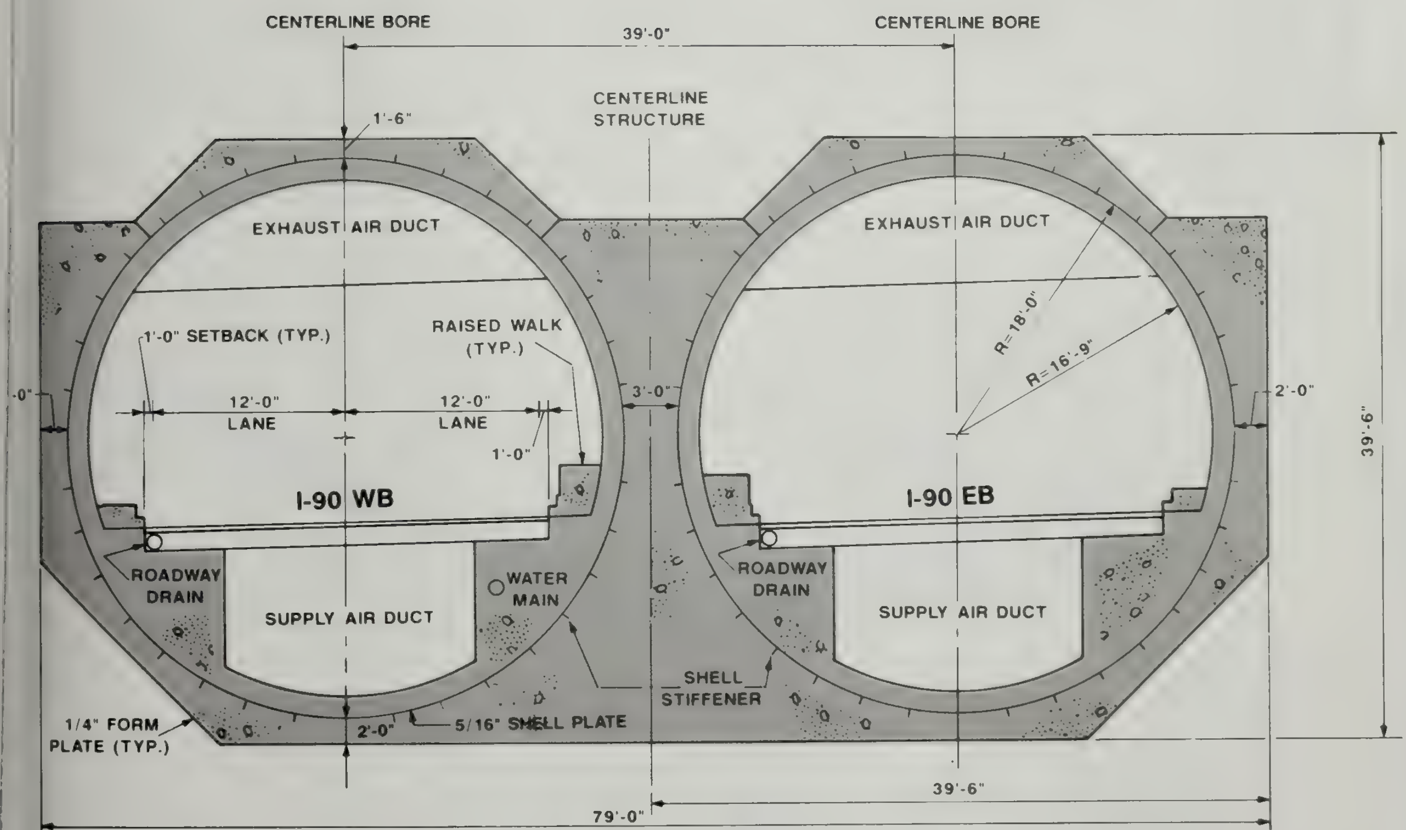
As stated in Chapter 1, a thorough review of all aspects of the Preferred Alternative in the FEIS/R was undertaken by the Department. The purpose of the review was to improve traffic operations, to mitigate potential impacts further, to address issues identified but left unresolved in the FEIS/R, and to recommend design concepts in response to changes in the affected (and projected) environment. Following are brief descriptions of the proposed major changes to the project design presented in the FEIS/R. (Refer to Figure 2.28 for locations of the changes.) A more detailed discussion of alternative designs studied in the following project subareas can be found in the Part II of the SEIS/R.

2.3.1 Area North Of Causeway Street

The Leverett Circle Connector Has Been Revised: In the Proposed Action design, as described previously in Section 2.2.1(a), the connector from I-93 to Leverett Circle will start on the north side of the Charles River and run south over the river on a double-deck elevated structure, parallel to and immediately west of the proposed I-93 northbound and southbound Charles River bridges. It will connect to the existing viaduct just north of the Boston Garden.

In the FEIS/R design, the Leverett Circle connector joined I-93 on the south side of the Charles River near Causeway Street. From there, the Leverett Circle connector curved out into the river along the south bank in tunnel and boat section to Leverett Circle.

The change improves the constructibility and the design in several ways. For example, the FEIS/R tunnels in the Charles River would require filling along the south bank; the Proposed Action design eliminates the need for that filling. The Proposed Action design also improves traffic operations by lengthening the weaving distances in both the FEIS/R design



SECTION A-A

TYPICAL CROSS-SECTION STEEL IMMERSED TUBE

Refer to Figure 2.22 for location of section.

FIGURE
2.23

Third Harbor Tunnel Area
Typical Section

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

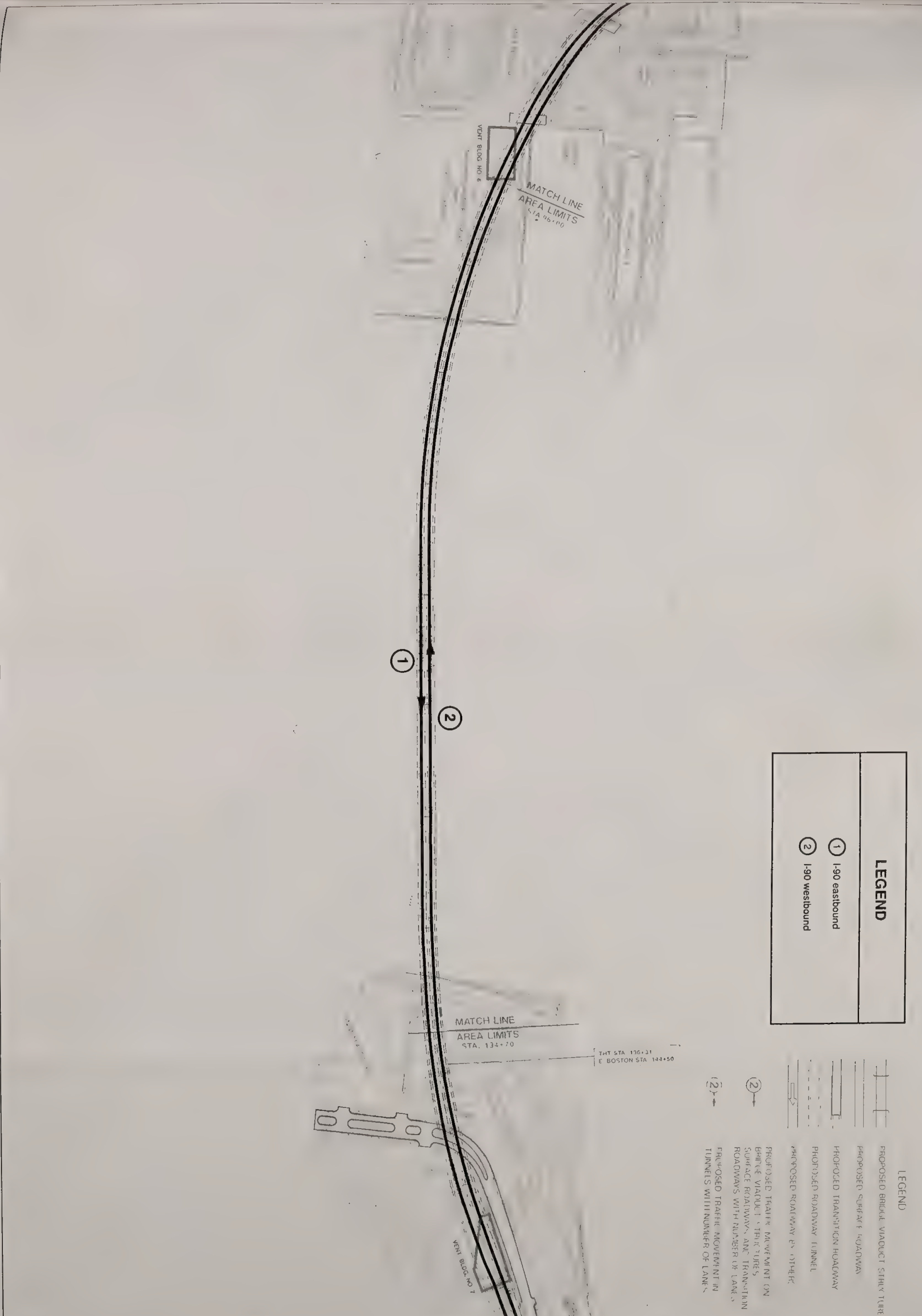


FIGURE 2.24

Third Harbor Tunnel Area Major Traffic Movements

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

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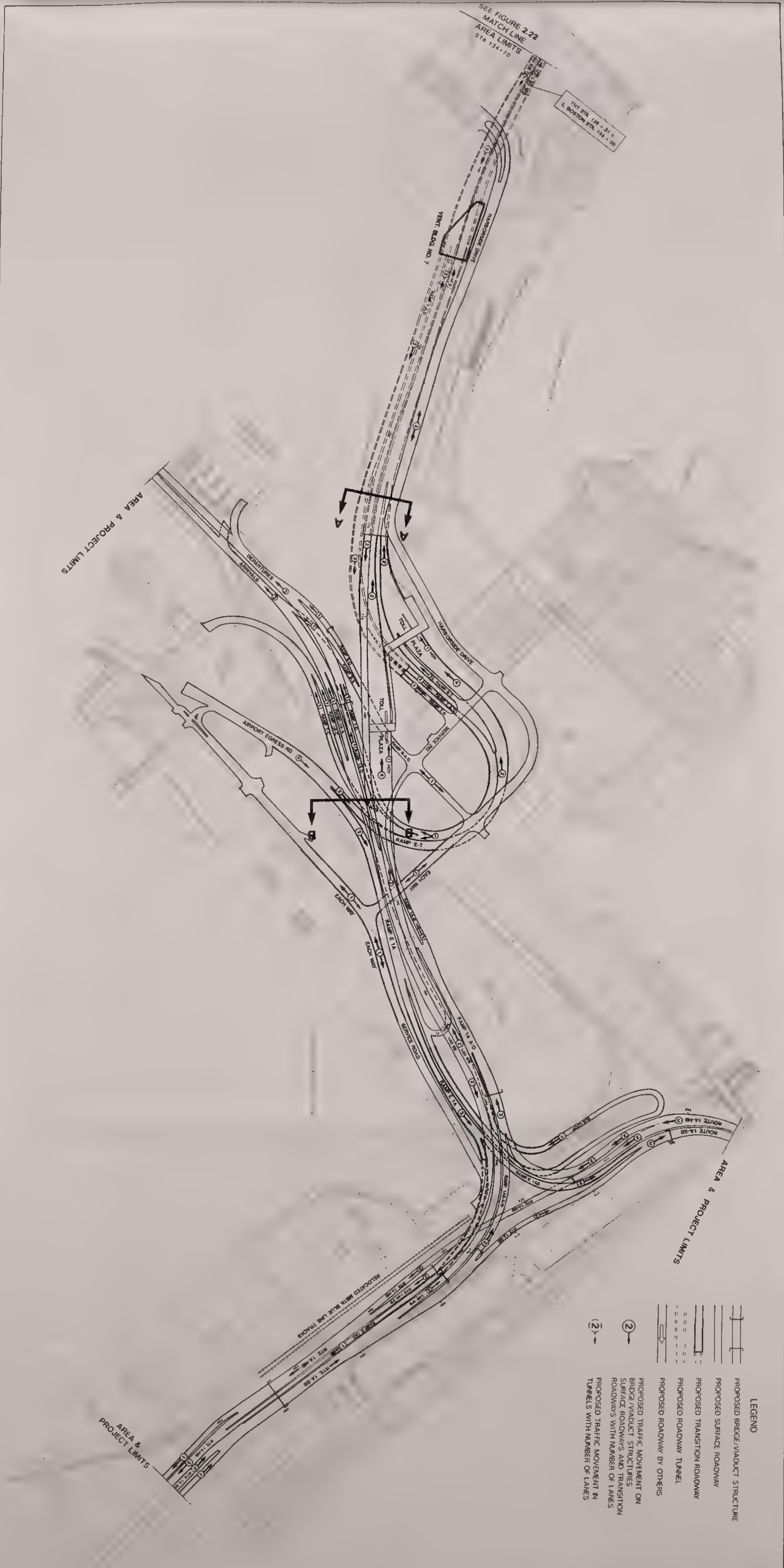

FIGURE 2.25

East Boston/Logan Airport Area Alignment

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

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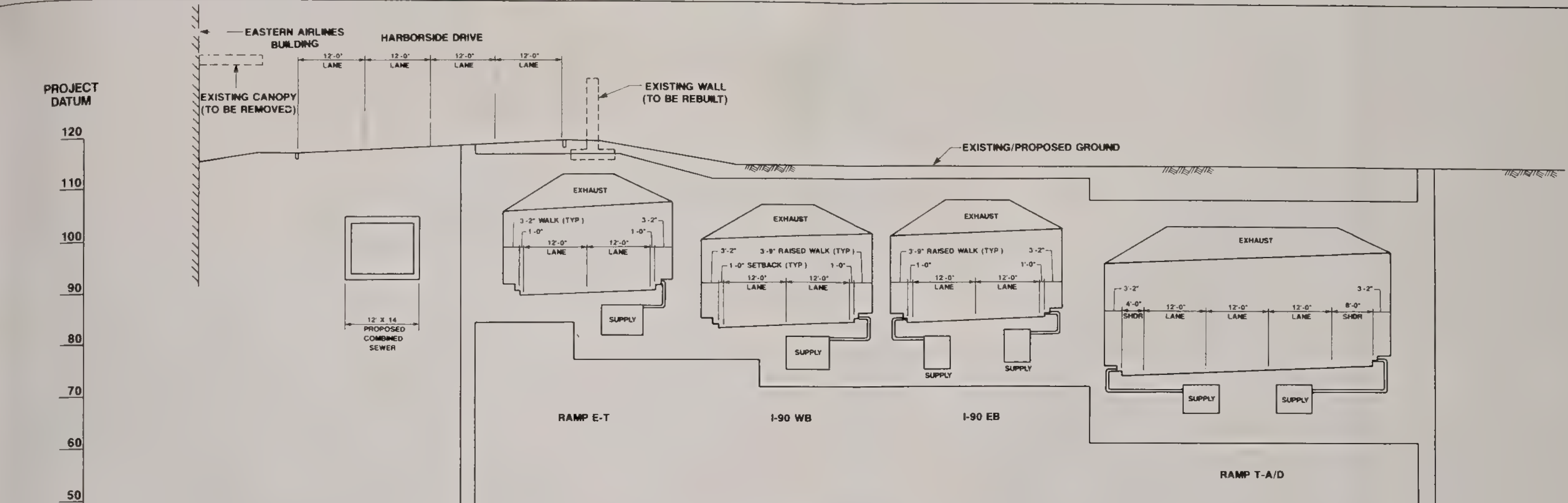
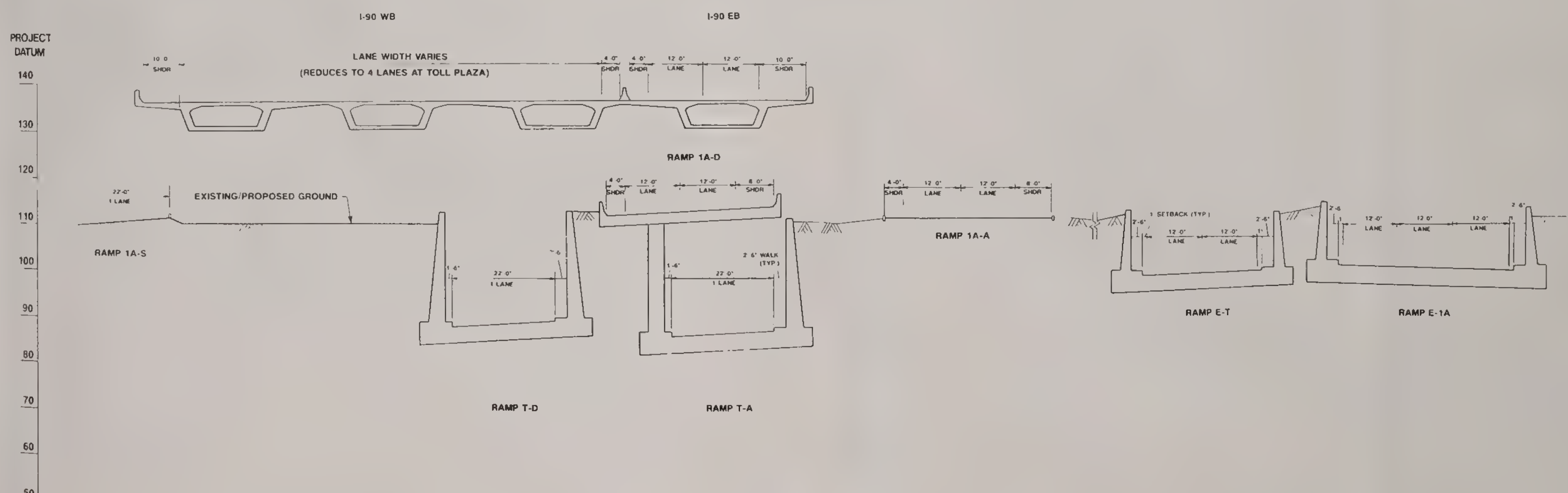


SECTION A-A
East of Massachusetts Technology Center



SECTION B-B
Between Eastern Air Cargo and Hilton Hotel

Refer to Figure 2.25 for location of sections.

FIGURE 2.26 **East Boston/Logan Airport Area Sections**

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

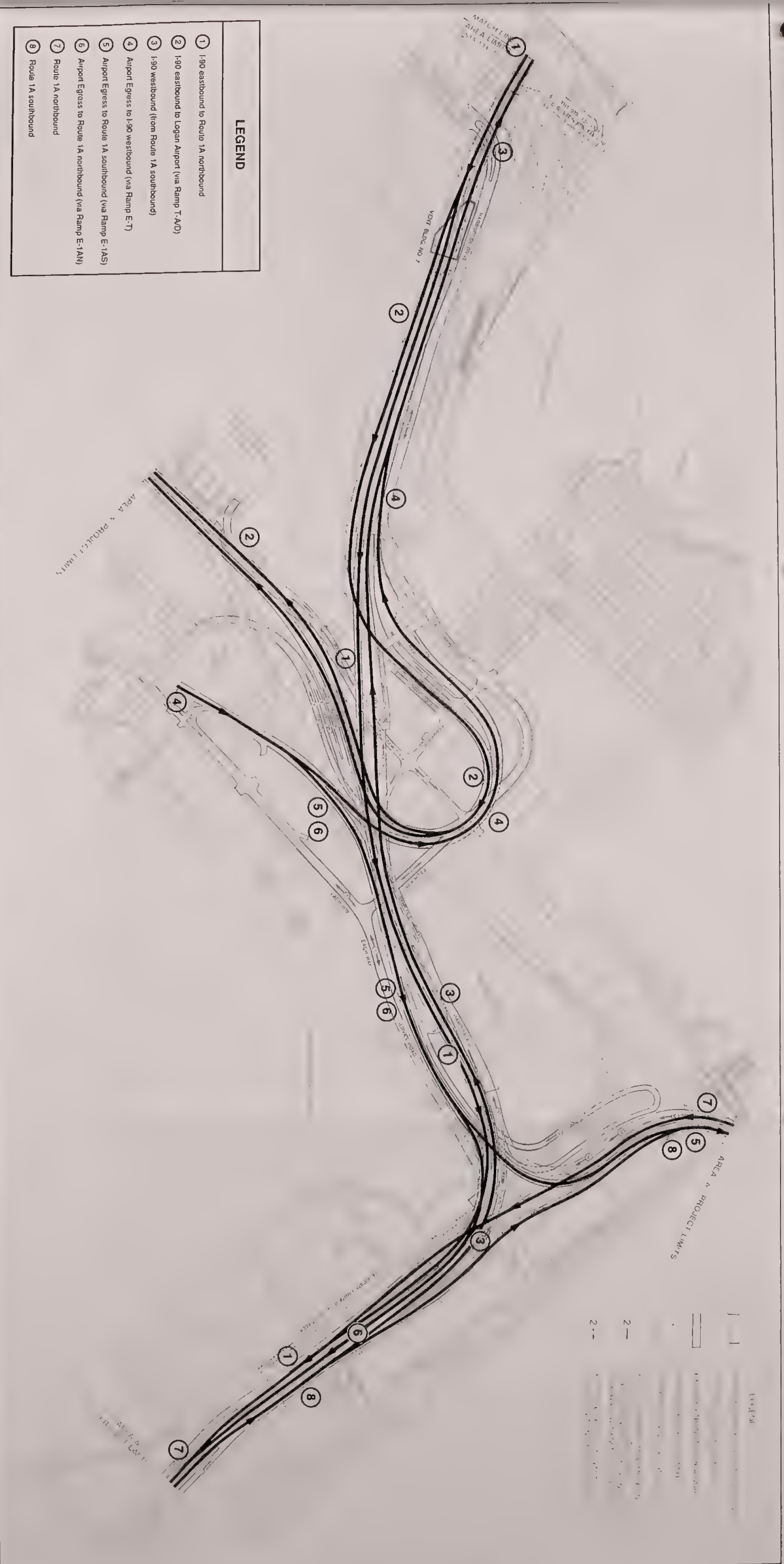


FIGURE 2.27 **East Boston/Logan Airport Area Major Traffic Movements**

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

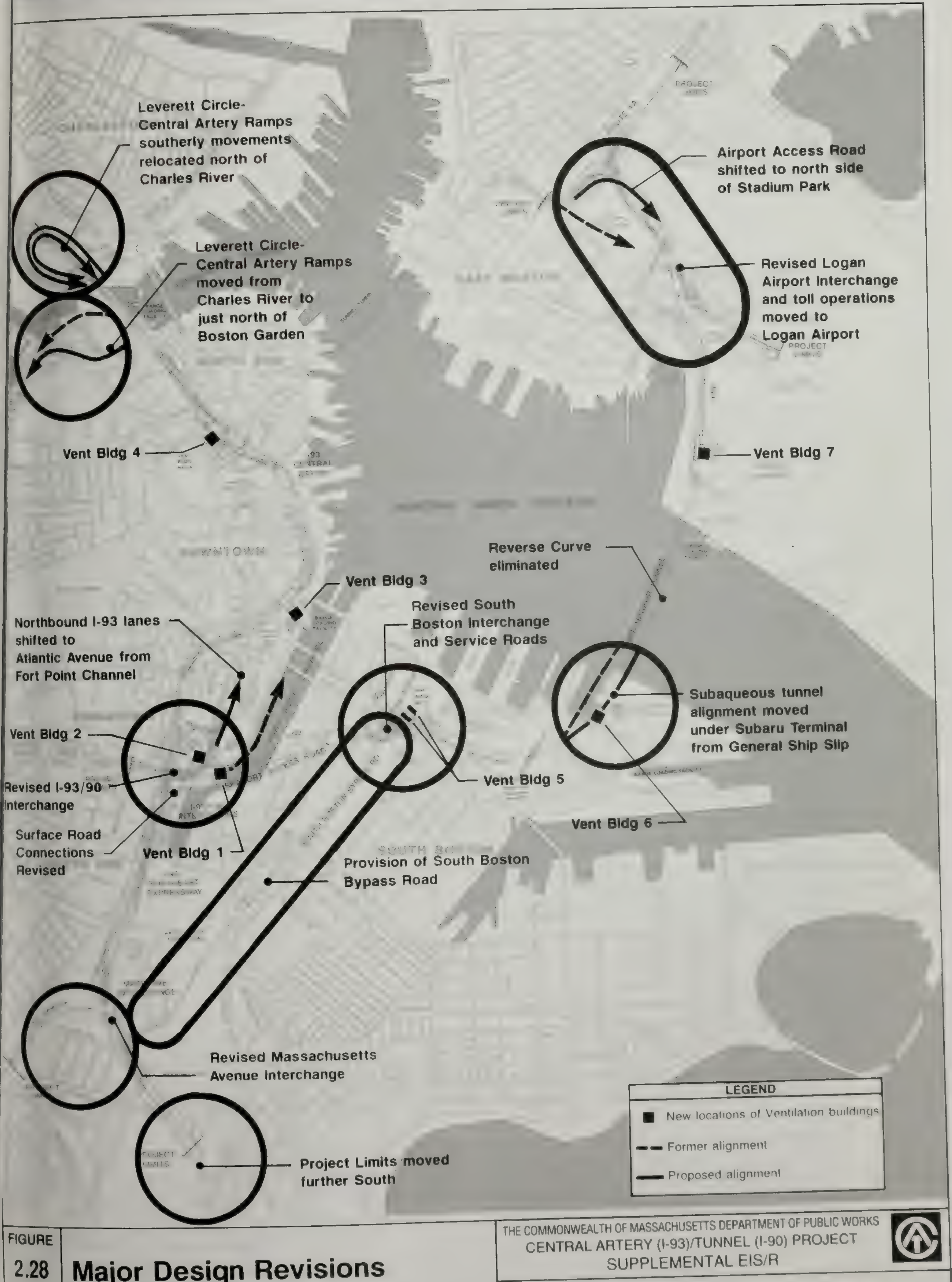


FIGURE 2.28

Major Design Revisions Since 1985 FEIS/R

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

and the existing condition by the addition of the Leverett Circle connector over the Charles River. Also, the Proposed Action design is compatible with plans for construction of a new arena on the land between the existing North Station/Boston Garden building and the Leverett Circle connector ramps, whereas the FEIS/R design was not.

2.3.2 Central Area

Northbound I-93 Lanes Have Been Shifted From Fort Point Channel To Under Atlantic Avenue: In the Proposed Action design, the northbound I-93 lanes will follow an alignment under existing Atlantic Avenue from the I-93/I-90 Interchange area to the Dewey Square area near South Station. This alignment differs from the FEIS/R design which proposed that the I-93 northbound lanes be in tunnel along the west side of Fort Point Channel.

Both the Atlantic Avenue alignment and the Fort Point Channel alignment were considered in the FEIS/R, but the Atlantic Avenue alignment was not selected at that time due to the assumption that the tunnel had to pass through the existing Red Line mezzanine at South Station. A major disruption of the existing and proposed facilities at South Station, which would have been caused by this construction, was considered unacceptable. A tunnel under the Red Line station was also considered in the FEIS/R but rejected since it was believed that deep tunneling would be too difficult.

During later design stages, however, more detailed engineering studies have been conducted on deep tunneling methods, and it has been determined that construction of a tunnel beneath the Red Line mezzanine at South Station is feasible. Consequently, construction alongside Fort Point Channel for the northbound mainline has been ruled out.

2.3.3 I-93/I-90 Interchange And Massachusetts Avenue Interchange Area

The Southern Project Limits Have Been Extended From North Of The Massachusetts Avenue Interchange To Approximately 500 Feet South Of Southampton Street: In the FEIS/R design the southern project limits were located in the vicinity of the Castle Metal Company north of the Massachusetts Avenue interchange. The Proposed Action design has moved those limits to approximately 500 feet south of Southampton Street. This change was necessary because the number of proposed southbound lanes has been increased to six lanes between West Fourth Street and the Castle Metal Company (the FEIS/R design specified only four lanes in this area). In order for six lanes of traffic to merge into the existing Southeast Expressway's three fully operational lanes (plus one lane operational during peak traffic hours), this segment of the Southeast Expressway must be modified to allow for a safe merge.

An Arterial Street And Frontage Road System Has Been Added To The Network Parallel To I-93 And I-90: The FEIS/R did not include an arterial street system in this area of the project. The proposed arterial street system will connect surface streets in the Central Area to those in the I-93/I-90 Interchange area. In addition, surface roads that currently parallel the I-90 Massachusetts Turnpike will be extended eastward to complete the network.

The Massachusetts Avenue Interchange Has Been Improved: The Massachusetts Avenue interchange has been revised to make optimum use of the expanded frontage road system. Traffic to and from I-93 southbound and northbound will use the frontage road system to access the Massachusetts Avenue connector. This system will eliminate the existing left-hand on- and off-ramps.

The I-93/I-90 Interchange Has Been Improved: Since the I-93 northbound alignment was shifted to the west under Atlantic Avenue, the connecting ramps to and from I-90 and surface streets were also moved and redesigned. As a result, the geometries of these redesigned ramps and connections have been improved from the FEIS/R designs.

2.3.4 South Boston/South Boston Bypass Road Area

The South Boston Bypass Road Has Been Added To The Design: The South Boston Bypass Road, as described in Section 2.2.4(a), has been added to the project. The first phase of it, the South Boston Haul Road, will accommodate truck traffic during construction. The completed Bypass Road will provide access to the Third Harbor Tunnel for high-occupancy vehicles and most trucks. It was not part of the Preferred Alternative described in the FEIS/R.

2.3.5 Third Harbor Tunnel Area

The Third Harbor Tunnel Alignment Has Been Refined: In the FEIS/R, the Third Harbor Tunnel entered Boston Harbor through a slip near the General Ship Pier 5 facilities in South Boston and then continued across the Harbor with a reverse curve, coming ashore at Bird Island Flats in East Boston. The Proposed Action design shifts the tunnel alignment eastward so that the tunnel will pass below the Subaru Terminal and will continue beneath the Harbor and into Bird Island Flats in East Boston. The Proposed Action, thus, both moves the tunnel out of most of the slip near General Ship Pier 5 and eliminates the reverse curve, improving the geometry. This shift in alignment substantially minimizes the impacts to General Ship and, thus, saves many jobs and the costs associated with those impacts.

Steel Immersed Tube Construction Has Been Selected: In the FEIS/R the type of material and method of construction for the tunnel were left unresolved; concrete and steel immersed tubes were the two types identified in the FEIS/R. The Proposed Action specifies the use of steel immersed tubes, constructed off-site and towed into Boston Harbor.

2.3.6 East Boston/Logan Airport Area

The Airport Access And Egress Roadways Have Been Revised: The FEIS/R design retained the existing Airport Access Road in its current location, but the Proposed Action design relocates the Airport Access Road to the northeast of the East Boston Memorial Stadium Park.

The proposed design relocates the access road to improve traffic operations, as well as to eliminate temporary construction impacts to the park. If the proposed access road remained where it is today, southwest of the stadium, construction would be required in the corner of the park in order to provide the required grade separation between the Airport Access Road and the crossing Airport Service Road, which connects to Harborside Drive. Relocation of the access road to the northeast will eliminate these construction impacts to the park.

The proposed Airport Egress Road will not follow the North Area Service Road, as was depicted in the FEIS/R. Instead, in the Proposed Action the Airport Egress Road will be shifted further eastward, parallel to the proposed access road.

The Toll Collection Facilities For The Third Harbor Tunnel Have Been Moved To Logan Airport: Tolls will be collected from westbound vehicles before entering the Third Harbor

Tunnel. The toll collection facilities will be located at Logan Airport in East Boston instead of in South Boston, which was the location indicated in the FEIS/R. The toll facilities have been moved to Logan Airport to improve roadway operations and safety. In the FEIS/R design, tolls were to be collected from vehicles as they travelled westbound on the I-90 mainline and emerged at freeway speeds from the Third Harbor Tunnel into South Boston. Operational and safety problems were likely since vehicles would be required to slow down and then stop on the mainline highway. This could cause backups in the tunnel, an undesirable and unsafe result. Also, since the FEIS/R design required relatively sharp horizontal and vertical curves approaching the toll plaza, sight distances would be limited. Recent refinements in the South Boston interchange design would require that multiple exits or ramp movements be located together immediately after the toll plaza, with insufficient weaving distances possible.

Location of the toll collection operation at Logan Airport will eliminate the need to stop traffic on the interstate mainline highway since tolls will be collected from vehicles while they are located on ramps and connectors prior to entering onto I-90 westbound. Vertical and horizontal curves and, thus, sight distances have been improved on the approaches to the toll collection areas, resulting in improved safety conditions. Also, the inadequate weaving distances in South Boston have been eliminated by moving the toll operations to Logan Airport, where longer signing distances and separate decision points are possible.

Several additional advantages result from locating the toll facilities at Logan Airport. For example, traffic studies show that during peak hours queues will develop on the westbound ramps and connectors at Logan Airport as vehicles approach the Third Harbor Tunnel. This will be caused by traffic merging down into two lanes to enter the tunnel, regardless of the location of the toll booths. Placing the toll collection booths on these ramps and connectors will enable operators to collect tolls from vehicles which are stopped and waiting for merging and eliminates the need for vehicles to make a second stop in South Boston, which would be the case if the toll booths were located there.

A second advantage is that by having the toll plaza at the eastern end of the Third Harbor Tunnel, operators will be able to meter vehicle flow into the tunnel during peak flow hours or emergencies.

2.3.7 High-Occupancy Vehicle (HOV) System

An Improved HOV System Has Been Incorporated Into The Proposed Action Design: The proposed HOV system will operate along portions of both I-93 and I-90. HOV roadways will be provided along the Southeast Expressway between Kneeland Street and the South Station Transportation Center and Boston Street, just past the Massachusetts Avenue interchange. These lanes will be separated from the northbound and southbound mainline lanes and will run between them. Movable barriers, or a similar system, will be used in some locations to direct traffic flow northbound during AM hours and southbound during PM hours.

Near the Massachusetts Avenue interchange, two other connector ramps have been included in the design to link I-93 northbound and southbound directly to the HOV lanes. These ramps have been incorporated in the Proposed Action so that the trucks and HOVs with points of origin or destination in downtown Boston, other than Kneeland Street or the SSTC, will have connections to future HOV facilities that may be developed in the Southeast Expressway corridor to points south.

HOVs will operate along I-90 on a proposed collector-distributor roadway system, as well as exclusive HOV roadways. In the Proposed Action, collector-distributor roadways will extend parallel to the I-90 mainline from the I-93/I-90 Interchange to the South Boston interchange. This collector-distributor system has been incorporated into the design to improve safety by reducing weaving problems associated with local traffic movements. Since the two interchanges are closely spaced, weaving distances are limited along the mainlines for traffic originating at a local street in one interchange and desiring egress at a local street in the other. Placing local traffic movements on the collector-distributor system will eliminate the weaving problems.

In the Proposed Action design, HOVs would use the collector-distributor roadway system to travel between the I-93/I-90 Interchange area, South Boston, and the Third Harbor Tunnel. HOVs leaving the southern portion of downtown at Kneeland Street will reach the eastbound collector-distributor system via the Albany Street Extension and a connecting ramp. HOVs from the I-90 Massachusetts Turnpike eastbound will enter the collector-distributor system from an exclusive ramp. The eastbound collector-distributor will run parallel to the I-90 mainline under Fort Point Channel into South Boston. Here, an exclusive HOV roadway will diverge to bypass the South Boston interchange and connect back to I-90 eastbound prior to entering the Third Harbor Tunnel. A traffic metering area and equipment will be located near the eastbound portal to the Third Harbor Tunnel to meter all traffic flow into the tunnel during periods of congestion and will provide operators with the ability to give HOVs priority to enter the tunnel, if desired. In addition, metering traffic flow will increase the potential to provide for public safety.

The HOV system westbound will begin at the west portal for the Third Harbor Tunnel in South Boston. At this point HOVs may exit onto an exclusive HOV roadway to bypass the South Boston interchange for access to the I-93/I-90 Interchange area or to proceed south on the South Boston Bypass Road. The westbound collector-distributor will parallel I-90 under Fort Point Channel and allow HOV access to the South Station Transportation Center or Kneeland Street. HOVs also will be able to rejoin I-90 westbound. This system will provide HOVs with queue bypass capability if traffic along the I-90 mainline is backed up.

HOVs on the collector-distributor roadway system will be mixed with general purpose traffic moving between the two interchanges.

Another major component of the HOV system will be the South Boston Bypass Road. The Bypass Road will provide HOVs with a direct connection between the Southeast Expressway (I-93) near the Massachusetts Avenue interchange and I-90 at the South Boston interchange. The frontage road system near the Massachusetts Avenue interchange will provide the connection between I-93 northbound and southbound and the Bypass Road northbound and southbound.

At the South Boston interchange, HOVs headed for the airport from the Bypass Road northbound will merge with HOVs from I-90 eastbound onto the exclusive ramp (described previously) to bypass the South Boston interchange. From here, HOVs will proceed through the portal merge area to enter the Third Harbor Tunnel. HOVs from the airport will reach the Bypass Road southbound via an exclusive ramp, also described above.

Exclusive HOV lanes will not be provided in the Third Harbor Tunnel. However, exclusive lanes will be provided for HOVs approaching the toll plazas at Logan Airport. Emergency

response and law enforcement operations will be located at the toll plazas to maintain traffic flow into the Third Harbor Tunnel. This system will also enable operators to favor HOVs as they enter the tunnel, if desired.

The above-mentioned lanes and facilities will combine to form a workable and manageable HOV system throughout the southern and eastern portions of the project.

2.3.8 Tunnel Ventilation

The FEIS/R Identified The Need For Nine Ventilation Buildings To Serve The Preferred Alternative Alignment. The Final Locations Of These Nine Ventilation Buildings, However, Were Left Unresolved Due In Part To The Need For A More Detailed Air Quality Analysis: Evolution of the project design since the FEIS/R has resulted in new requirements for ventilation by redefining tunnel lengths, numbers of travel lanes, location and length of access and egress ramps, etc. The final result is an alignment which requires only seven ventilation buildings, each one serving a discrete sector of the project. Each of those ventilation sectors is defined by subsurface constraints, such as MBTA tunnel crossings or the tunnel portals.

The final selection of sites for these seven ventilation buildings results from an intensive alternative evaluation and screening process which was based on a full range of criteria including public health and safety, air quality, land use, water resource impacts, visual impacts, and historic resources, as well as technical feasibility and costs. This analysis is the subject of the Ventilation Building Site Report, a technical report that describes the screening process that was employed to reduce the initial 189 candidate sites down to seven. Air quality impacts of the tunnel ventilation system are described in Chapter 4; land use and visual characteristics of the ventilation buildings are described in Chapters 8 and 9, respectively. Detailed graphics of the ventilation buildings are located in the SER.

2.4 RESOLUTION OF ISSUES RAISED BY PUBLIC AGENCIES

The Army Corps of Engineers requested that the description of the Proposed Action be revised to support impact assessment. The Proposed Action description has not been revised, but information needed to support Corps permit applications has been provided throughout the SEIS/R and in the Section 404(b)(1) appendix (for Wetlands).

The City of Boston requested expanded discussion of the HOV system for the project. An HOV roadway section has been added to this chapter.

Chapter 3 – Transportation

Chapter 3
TRANSPORTATION

This chapter describes the impacts of the Proposed Action on transportation facilities and operations. Existing transportation conditions are discussed in Section 3.1, focusing on changes in conditions since the FEIS/R. The section includes an overview of the highway network, followed by documentation of the substantial growth in traffic that has occurred since the FEIS/R. The average increase in daily traffic in the study area was 26 percent at locations where comparable data are available for 1982 and 1987/88. Traffic operations on area roadways also are described in Section 3.1, as is the critical and complementary role of public transit in meeting the region's transportation needs.

Section 3.2 presents the impacts of the Proposed Action on vehicle traffic volumes, roadway operations, public transportation, and pedestrian circulation in the design year 2010. Beneficial impacts of the project will include improved traffic operations on I-93, better access to downtown Boston and Logan Airport, and improved operating conditions for high-occupancy vehicles. As a result of the Proposed Action, the Central Artery will carry 24 percent higher daily traffic volumes, while operating speeds generally will improve to the 30- to 40-mph range on most segments of the I-93/I-90 mainline in peak commuting hours. The Proposed Action also will result in a substantial shift in traffic off local streets and onto the mainline highway system, in response to the increase in capacity on I-93 and the extension of I-90. With the Proposed Action in place, daily traffic will decline by an average of 9 percent on a cross section of local streets throughout the study area, compared to year 2010 conditions without the project. On city streets that serve as gateways to downtown Boston, the project will cause even more marked decreases in daily traffic volumes compared to year 2010 conditions without the project, including reductions of 28 percent on the Summer Street bridge; 65 percent on the Congress Street bridge; and 30 percent on the Charlestown bridge. Average speeds on all roadway facilities will increase by 44 percent in the entire study area, and by over 90 percent downtown, as a result of the Proposed Action.

Mitigation measures designed to serve as permanent features of the regional transportation system are described in Section 3.3. The chapter concludes by comparing project impacts with those of the Preferred Alternative in the FEIS/R; the changes in impacts are due to refinements in the project design and in the forecasting methodology developed since the FEIS/R.

3.1 AFFECTED ENVIRONMENT

Corresponding to the rise in employment in Boston between 1975 and 1985, there has been an estimated increase in total travel of 25 percent (from 8.1 million to 10.1 million person trips per day) by all transportation modes combined. Approximately 17 percent of total regional person trips in 1987 had origins or destinations within the transportation study area for the Artery/Tunnel Project. (The boundaries of the study area are shown in Figure 3.1.)

Between 1976 and 1988, the amount of office space in the City of Boston grew by approximately 1.5 million square feet annually. The accompanying growth in employment has

resulted in substantial increases in travel concentrated in downtown Boston. Also adding to the total volume of trips in the study area has been unprecedented growth in travel to and from Logan Airport. Between 1977 and 1987, the number of passengers flying in and out of the airport grew 93 percent, from 12.1 million to 23.3 million passengers, an average of 1.1 million passengers annually. (In contrast, from 1970 to 1977, the number of annual Logan Airport air passengers grew from 9.4 million to 12.1 million passengers, an increase of only 29 percent, or 386,000 passengers annually.)

3.1.1 Highway And Street Network

Figure 3.2 shows the highway system serving the Boston metropolitan area. Radial highways providing access to and from Boston are identified below by the corridors they serve:

- o North Shore - U. S. Route 1; State Route 1A; Interstate 95 (I-95)
- o North - I-93
- o Northwest - State Route 2; Storrow Drive; State Route 3
- o West - Massachusetts Turnpike (I-90)
- o Southwest - U.S. Route 1; I-95 (south of Route 128 circumferential)
- o South Shore - Southeast Expressway (I-93); State Route 3

Additional key elements in the radial highway system are the Tobin Bridge (Route 1) and the Callahan/Sumner Tunnels, which provide connections between downtown Boston and areas to the north across the Mystic River and Boston Harbor.

The metropolitan area's radial highways are linked by Route 128, a circumferential highway ringing Boston on the north, west, and south approximately 8 miles from downtown Boston. Route 128, which has been the focus for much of Massachusetts' renowned growth in high technology industries, also generally defines the limit of the region's traditional inner suburbs.

The Central Artery, which is the section of I-93 that traverses downtown Boston, serves two crucial functions. Built in the 1950s as a "collector-distributor" serving downtown Boston, the highway is the principal means of roadway access between downtown Boston and the north via I-93 and Route 1, the south via the Southeast Expressway, the west via the Massachusetts Turnpike, and Logan Airport via the Sumner and Callahan Tunnels. The Central Artery also fulfills a critical role in the broader regional highway network, providing the only direct link east of Route 128 between the expressways to the north and south of Boston.

The Central Artery is an overcrowded facility, having inadequate features and carrying traffic volumes far in excess of its design capacity. The accident rate on the Central Artery, which was not built to interstate standards, is approximately twice the nationwide average for the interstate system. At the Artery's peak load point, traffic averages 191,000 vehicles per day, compared to the daily volume of 75,000 vehicles expected when the highway was designed. Additional deficiencies contributing to severe congestion on the highway are the absence of breakdown lanes and the large number of ramps separated by short weaving distances, causing serious operational problems. There are 42 entrance and exit ramps on I-93 between Columbia Road on the Southeast Expressway and Route 1 north of the Central Artery (a distance of approximately 4 miles) in both northbound and southbound directions. On the Central Artery between Kneeland Street and the Charles River high bridge (about 1.75 miles), there are 23 entrance and exit ramps.

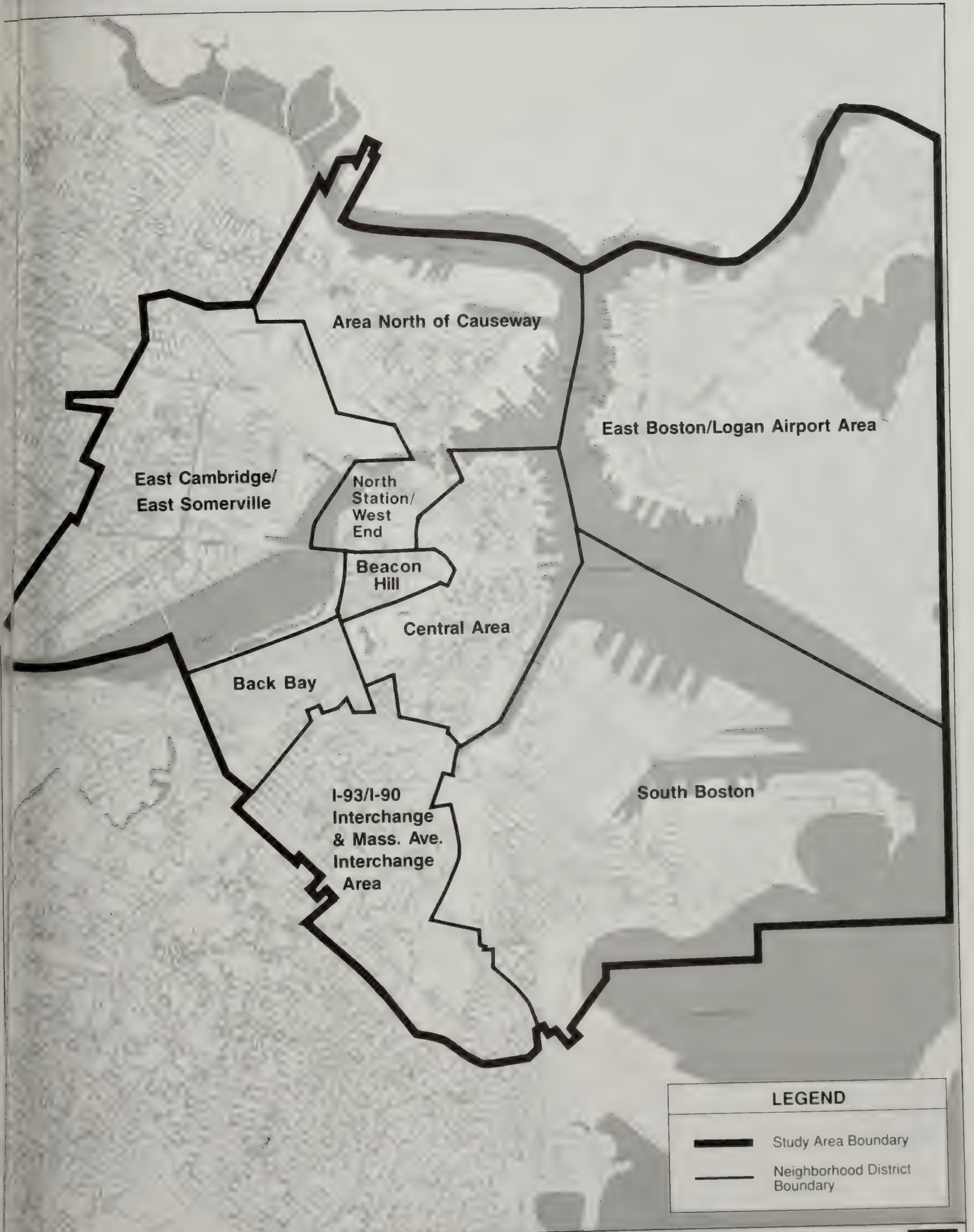


FIGURE 3.1 **Transportation Study Area**

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

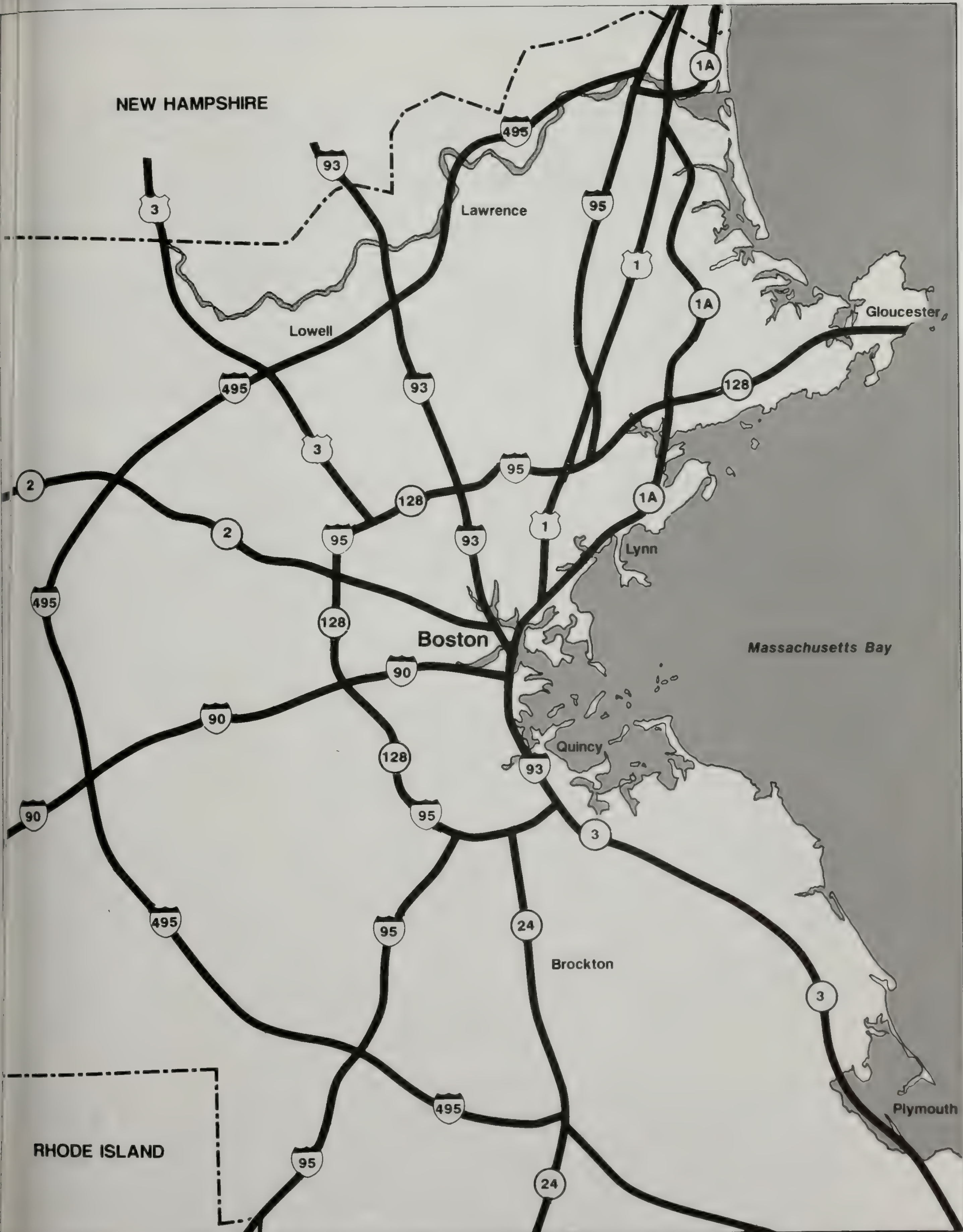


FIGURE 3.2 **Regional Highway System**

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

The entire Central Artery is six lanes wide, with three lanes in each direction, except in the segment immediately to the south of the high level bridge over the Charles River, where through traffic is limited to two lanes in each direction. This segment is the worst operational bottleneck in the regional highway network, causing severe traffic congestion on upstream sections of the Artery, which spill over onto City streets. Traffic volumes per lane are among the highest on the entire interstate system nationwide.

An extensive system of local roadways connects to the regional highway system. The streets of downtown Boston, some of which were laid out in the 17th century, do not conform to a grid pattern. The irregular street pattern, narrow width of many streets, frequency of intersections, and prevalence of pedestrians serve to limit the capacity of the network. There is, nevertheless, a hierarchy of roadways, which provides a recognizable and generally functional circulation system for knowledgeable motorists.

3.3.1(a) Changes To The Roadway Network

The roadway network remains essentially the same as it was described in the FEIS/R. There have been, however, several specific and localized physical or operational changes. The Southeast Expressway, which adjoins the southern end of the project, was reconstructed over a 2-year period beginning in 1984. Reconstruction consisted of resurfacing, bridge rebuilding, and rebuilding of ramps to improve safety associated with use of breakdown lanes as a fourth travel lane during peak travel periods. These improvements did not substantially alter the capacity of the roadway.

Another change was the implementation (in 1983) of one-way tolls, inbound towards the City, on the Tobin Bridge and the Callahan/Sumner Tunnels. Previously, tolls had been collected in both directions. Concurrent with this change, the entrance ramps to the Callahan Tunnel were channelized. These operational improvements in combination have increased effective capacity and reduced delays in the Callahan Tunnel, although bottlenecks on the Central Artery and surface streets leading to the tunnel remain. Operations in the Sumner Tunnel have not been affected by the one-way tolls/channelization improvements.

The single major change in the regional highway system is the Central Artery North Area (CANA) Project, now under construction. CANA involves the reconstruction of the I-93/Route 1 interchange in Charlestown, at the northern end of the Artery/Tunnel Project, which will eliminate the existing weave between the two highways on the Charles River high bridge. Two loop ramps will be constructed, which will serve as a new interchange between I-93 and Route 1, lengthening merge and weave distances, improving sight lines, and providing acceleration and deceleration lanes. In addition, Route 1 will be placed in tunnels beneath City Square in Charlestown, which will allow removal of the existing elevated highway structure and improvements to surface streets. The Artery/Tunnel Project design will join with the CANA project in one interchange.

Within the study area local street network, there have been several street pattern changes, notably the reversal of direction on Charles Street in the Beacon Hill neighborhood, and traffic management measures to improve operations on the street system in downtown Boston. Functional capacity has been increased as a result of on-street parking restrictions implemented on Congress, Arlington, Tremont, and Cambridge Streets. The City of Boston has found that this program has produced reductions in vehicle travel times of 30 percent on Congress, Arlington, and Tremont Streets, combined, and 20 percent on Cambridge Street. The City plans to expand the program to Stuart/Kneeland and Boylston/Essex Streets.

The City also has instituted new planning mechanisms to foster effective traffic management. Under zoning code provisions implemented in December 1987, Transportation Access Plans must be submitted by developers for all proposed developments of over 100,000 square feet and for those within designated BRA planning districts, i.e., Interim Planning Overlay Districts. Transportation Access Plans are required to describe and evaluate traffic and parking impacts for each project during construction and when completed. A plan also must be provided describing how adverse impacts are to be mitigated through measures designed to reduce automobile use by building occupants. In the future, local traffic operations will benefit further from the planned implementation of additional traffic management measures, computerization of traffic signals, and a Traffic and Emergency Control Center (TECC) to monitor traffic operations and coordinate the response to emergencies.

3.1.2 Traffic Volumes

Traffic volume data were collected throughout the study area in 1987 and 1988 for the SEIS/R. The data generally are representative of existing conditions, with the exception of temporary impacts associated with construction of the CANA project, and reconstruction of the Broadway bridge and East Berkeley Street, all of which currently are underway. Data on existing traffic volumes serve as the basis for forecasting future traffic conditions, which is required for the planning, design, and evaluation of new facilities and mitigation strategies. Traffic volume data presented in this section consist of both average weekday traffic (AWDT) and peak hour traffic ground counts. Table 3.1 presents the 1987/1988 AWDT volumes and comparable data for 1982, as reported in the FEIS/R.

AWDT volumes have increased on most roadways since 1982, reflecting the pace of development that has occurred in the Boston area during the past several years, which in some locations, such as the Northern Avenue Bridge, the growth was only 5 percent. The average percentage increase in AWDT from 1982 to 1987 was 26 percent at all locations where data were available for both years.

Traffic volume increases at the major entry points to downtown Boston are of special interest. For northern entries, represented by I-93 and the Tobin Bridge, 24-hour traffic increased about 35 percent between 1982 and 1987, while Sumner/Callahan Tunnel volumes increased about 20 percent during this 5-year period. Traffic on the western entry routes, represented by the Massachusetts Turnpike and Storrow Drive, increased 15 percent and 27 percent, respectively. Traffic volumes on the principal southern route to Boston (the Southeast Expressway) increased about 20 percent during the 5-year period ending in 1987.

Traffic volumes on the Central Artery, which connects the entry points discussed above, increased by 14,000 vehicles per day (VPD) at some locations to 37,000 VPD at other locations between 1982 and 1987. These increases range from 9 to 30 percent. At Logan Airport, 24-hour traffic on the access/egress roads increased from 55,450 VPD in 1982 to 76,000 VPD in 1987, a 5-year increase of 37 percent.

3.1.3 Traffic Operations

Morning and evening peak hours in the study area currently are characterized by a high degree of congestion on many sections of the highway network. While this is not unusual in the environs of a large city, several factors particular to the study area aggravate conditions that are otherwise typical of urban transportation systems. These are:

Table 3.1

COMPARISON OF 1982 AND 1987/88 AVERAGE WEEKDAY TRAFFIC VOLUMES

Roadway Links	1982	1987/88	Percent Change
Sumner/Callahan Tunnels	82,800	99,000	19.6
Tobin Bridge, North of I-93 Ramps	72,500	96,000	32.4
I-93, North of Tobin Bridge Ramps	89,450	122,500	36.9
Central Artery:			
Between CANA and Storrow Drive Ramps	142,100	179,000	30.0
Between Causeway Street and Sumner/Callahan Ramps	161,700	191,000	18.2
Between Callahan/Sumner Ramps and High Street Ramps	164,500	189,000	14.9
Between Northern Avenue and Beach Street Ramps	166,200	187,000	12.5
Between Albany Street and Massachusetts Avenue Ramps	153,700	167,500	9.0
Southeast Expressway:			
Between Columbia Road and Southampton Street Ramps	162,300	190,000	17.1
South of Columbia Road Ramps	151,620	184,000	21.4
Massachusetts Turnpike, West of Central Artery	71,200	82,000	15.2
Storrow Drive, West of Copley Square Ramps	84,000	106,000	26.8
Route 1A, North of Neptune Road	30,825	43,000	39.5
Logan Airport Access/Egress Roads	55,450	76,000	37.1
Maverick Street, Between Cottage And Orleans Streets	4,200	6,200	47.6
Sumner Street, Between Orleans and Cottage Streets	2,400	4,200	75.0
Meridian Street, Northwest of Condor Street	15,100	19,820	31.3
Summer Street Bridge, East of Fort Point Channel	27,000	30,000	11.1
Congress Street, East of Fort Point Channel	11,000	16,000	45.5
Northern Avenue, East of Fort Point Channel	18,050	19,000	5.3
West Fourth Street Bridge	11,000	13,000	18.2
Broadway Bridge	20,600	32,000	55.3
North Washington Street, Between Keany Square and Cross Street	21,550	27,490	7.5
Charlestown Bridge	43,000	47,000	9.3
Charles River Dam/O'Brien Highway	42,000	46,000	9.5
Gilmore Bridge	28,000	30,000	7.1

Source: Ground counts taken in 1982 and 1987/88

- o inadequate capacity on the Central Artery, connecting segments of the Southeast Expressway, and the Sumner/Callahan Tunnels, which constitute the major gateways to downtown Boston and critical links in the regional highway network

- o spillover of traffic using local streets to avoid congested sections of the above highway segments

- o a highly compact and irregular pattern of surface roadways, particularly in downtown Boston, which constrains the capacity of the local street system

These conditions are documented below, following a summary of the methods and terminology used in the analysis of traffic operations. Since the FEIS/R was written, the state of the art methods used in analyzing traffic operations have changed substantially, providing more accurate results. The current standard practice, applied in preparing this SEIS/R, is the use of the 1985 Highway Capacity Manual (HCM). Because of the difference in analysis methods, direct comparisons between the FEIS/R and the SEIS/R in terms of traffic operations are apt to be misleading. Therefore, existing traffic conditions are described in this section without specific reference to the level of service calculations contained in the FEIS/R. Generally, traffic operations have deteriorated since the FEIS/R was written, as a result of traffic growth. Worsening conditions are manifested in increased peak hour congestion, more widespread traffic delays, and extension of congested operations to more hours of the day.

The concepts of capacity and level of service (LOS) are central to the analysis of all intersections and highway ramp/weave areas. LOS can range from "A," representing free-flowing traffic, to "F," in which demand traffic volumes exceed highway or intersection capacity. Generally, LOS C is considered the standard defining acceptable traffic operating conditions. LOS D denotes delays within a generally tolerable range, particularly within urban areas. LOS E indicates travel operations at or approaching capacity, where small disruptions can result in substantial delays; LOS E is sometimes viewed as an acceptable condition in urban areas for short periods of time. LOS F is characterized by unstable flows, long delays, and travel demands that frequently exceed roadway capacities.

3.1.3(a) Operating Characteristics Of Traffic In Study Area

Table 3.2 shows volumes, speeds, weaving section speeds (where applicable), and levels of service (LOS) for the highway system in the study area, including the Central Artery, connecting segments of I-93, Route 1, Route 1A in the vicinity of Logan Airport, and the Sumner/Callahan Tunnels. (The locations of highway segments included in the table are shown in Figure 3.3.)

In the AM peak period, the Central Artery and connecting segments of the Southeast Expressway all operate at LOS E or F, except for the northbound segments of the Central Artery between the Callahan Tunnel off-ramp and the Storrow Drive off-ramp, which operate at LOS D, and the southbound segments of the Southeast Expressway south of Massachusetts Avenue, which also operate at LOS D. The poor quality of traffic operations on the Central Artery is caused by several severe bottlenecks on the highway, the absence of acceleration and deceleration lanes, excessive traffic volumes relative to capacity, and the prevalence of weaves caused by the high number of entrance and exit ramps crowded into a distance of under 2 miles. The Sumner Tunnel operates at LOS E in the AM peak hour, due to congested traffic operations at the Central Artery portal.

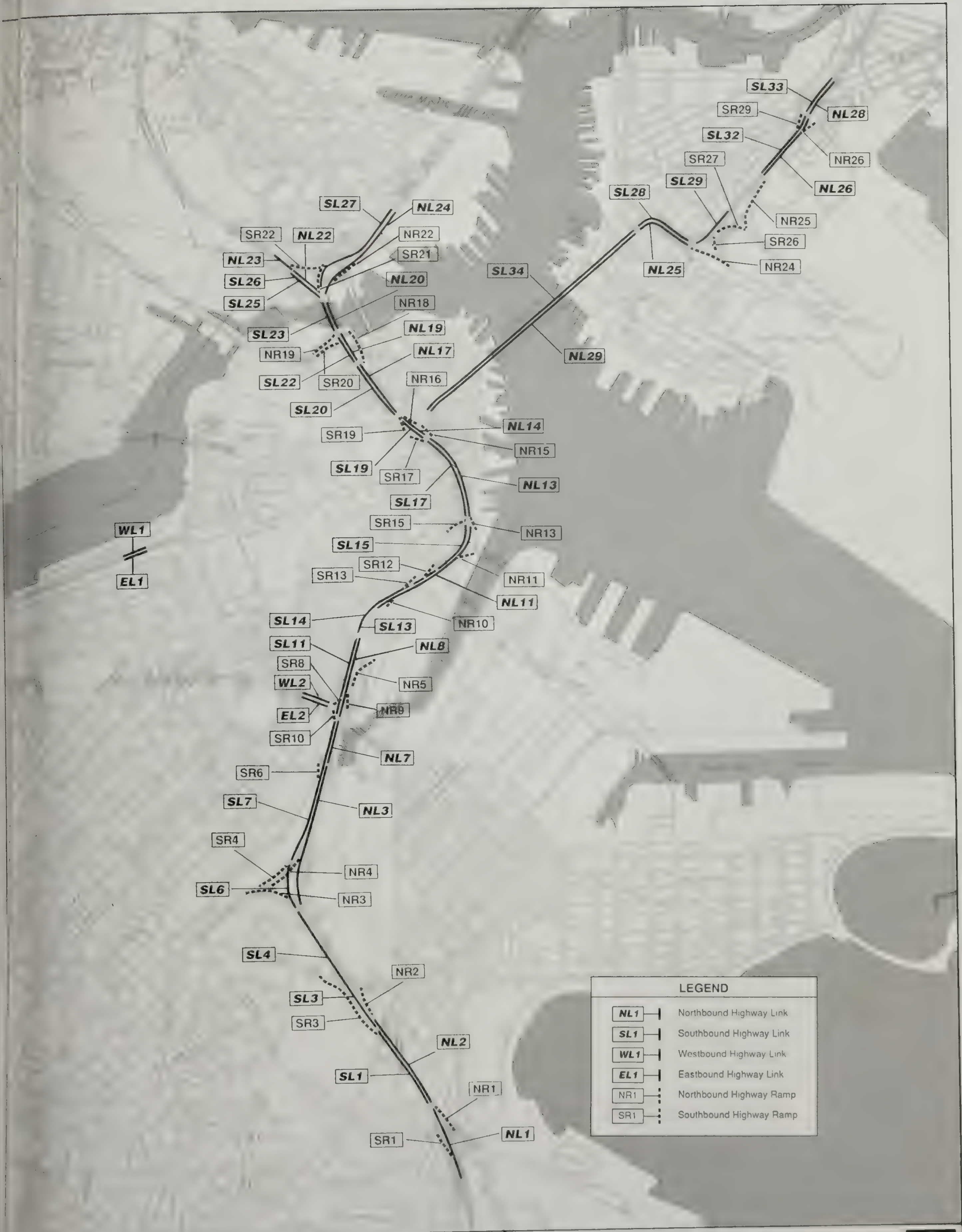


FIGURE 3.3

Mainline Highway Segments - Existing

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

0 1000 2000 3000 4000 Feet

Table 3.2

EXISTING 1987/88 TRAFFIC CONDITIONS HIGHWAY LINKS

Highway Links	Peak Hourly Volume (vph) AM	Peak Hourly Volume (vph) PM	Peak Hourly Speed (mph) AM	Peak Hourly Speed (mph) PM	Weaving Section Computed Speed (mph) Weave AM	Weave PM	Non-weave AM	Non-weave PM	Level of Service AM	Level of Service PM
Northbound Links										
Southeast Expressway Between:										
NL1 Columbia Road Off- and On-Ramps	6,700	3,700	17	45	N/A	N/A	N/A	N/A	F	C
NL2 Columbia Road On- and Southampton Street Off-Ramps	7,600	4,400	32	40	N/A	N/A	N/A	N/A	F	D
NL3 Massachusetts Avenue and East Berkeley Street On-Ramps	4,660	2,500	17	17	N/A	N/A	N/A	N/A	F	E
NL7 East Berkeley Street On- and I-90/Kneeland Street Off-Ramps	5,630	3,450	32	15	N/A	N/A	N/A	N/A	F	F
NL8 I-90/Kneeland Street Off- and I-90/Broadway On-Ramps	4,060	1,850	28	6	N/A	N/A	N/A	N/A	E	F
Central Artery Between:										
NL11 South Street On- and Northern Avenue Off-Ramps	6,430	4,050	30	7	29	33	46	47	E	F
NL12 Congress Street On- and Northern Avenue Off-Ramps	5,580	3,100	29	7	N/A	N/A	N/A	N/A	F	F
NL13 Northern Avenue On- and Callahan Tunnel Off-Ramps	6,100	4,300	34	9	N/A	N/A	N/A	N/A	F	F
NL14 Callahan Tunnel Off- and Sumner Tunnel On-Ramps	4,425	3,050	38	7	N/A	N/A	N/A	N/A	D	F
NL17 Sumner Tunnel On- and Causeway Street Off-Ramps	6,000	4,200	38	7	21	27	38	46	D	F
NL19 Storrow Drive Off- and On-Ramps	2,900	3,150	22	7	N/A	N/A	N/A	N/A	F	F
NL20 Storrow Drive On- and Route 1 (Tobin Bridge) Off-Ramps	4,600	5,600	19	21	20	18	20	18	F	F
NL22 I-93 Between Route 1 Ramps	2,550	3,350	47	45	N/A	N/A	N/A	N/A	B	C
NL24 Route 1 North of I-93 Ramps	2,950	3,150	44	43	N/A	N/A	N/A	N/A	C	C
Route 1A Between:										
NL25 Toll Plaza and Logan Airport Off-Ramp	2,550	3,100	31	30	N/A	N/A	N/A	N/A	C	D
NL26 Logan Airport On- and Neptune Road Off-Ramps	1,750	3,770	45	32	--	--	--	--	B	D
NL29 Callahan Tunnel	2,700	3,500	40	39	N/A	N/A	N/A	N/A	D	E

Table 3.2 (Cont.)

EXISTING 1987/88 TRAFFIC CONDITIONS
HIGHWAY LINKS

Highway Links		Peak Hourly Volume (vph) AM	Peak Hourly Volume (vph) PM	Peak Hourly Speed (mph) AM	Peak Hourly Speed (mph) PM	Weaving Section Computed Speed (mph) Weave AM	Weave PM	Non-weave AM	Non-weave PM	Level of Service AM	Level of Service PM
Southbound Links											
Southeast Expressway Between:											
SL1	Southampton Street On- and Columbia Road Off-Ramps	4,700	7,300	48	32	N/A	N/A	N/A	N/A	D	E
SL4	Massachusetts Avenue On- and Boston Street Off-Ramps	5,120	7,380	44	35	N/A	38	N/A	44	D	E
SL6	Massachusetts Avenue Off- and On-Ramps	4,570	6,150	37	34	N/A	N/A	N/A	N/A	D	F
SL7	East Berkeley/Albany Streets On- and Massachusetts Avenue Off-Ramps	5,300	6,800	42	15	35	28	45	40	E-D	F
Central Artery Between:											
SL11	I-90/Kneeland On- and East Berkeley Street Off-Ramps	5,270	5,350	40	9	29	29	46	47	F-D*	F
SL13	Beach Street and I-90/Broadway Off-Ramps	4,900	5,100	38	14	N/A	N/A	N/A	N/A	E	F
SL14	Congress Street On- and Beach Street Off-Ramps	5,400	5,400	40	10	31	29	44	41	D	F
SL15	Purchase Street On- and Summer Street Off-Ramps	5,500	4,400	36	7	29	37	41	44	F-D*	F
SL17	Haymarket On- and High Street Off-Ramps	6,100	3,900	35	7	N/A	N/A	N/A	N/A	E	F
SL19	Callahan Tunnel Off- and Haymarket On-Ramps	4,700	3,150	27	7	N/A	N/A	N/A	N/A	E	F
SL20	Causeway Street On- and Callahan Tunnel Off-Ramps	6,000	3,900	31	20	19	25	32	43	F-E*	E
SL22	Leverett Circle On- and Haymarket Off-Ramps	4,800	3,250	29	25	20	28	34	40	F-E*	E
SL23	Route 1 On- and Storrow Drive Off-Ramps	4,900	4,550	22	22	19	20	19	20	F	F
SL25	I-93 Between Route 1 Ramps	3,100	2,650	20	21	N/A	N/A	N/A	N/A	F	E
SL27	Route 1 North of I-93	1,850	2,750	8	18	N/A	N/A	N/A	N/A	F	F

Table 3.2 (Cont.)

EXISTING 1987/88 TRAFFIC CONDITIONS
HIGHWAY LINKS

Highway Links		Peak Hourly Volume (vph) AM	Peak Hourly Volume (vph) PM	Peak Hourly Speed (mph) AM	Peak Hourly Speed (mph) PM	Weaving Section Computed Speed (mph) Weave AM	Weave PM	Non-weave AM	Non-weave PM	Level of Service AM	Level of Service PM
Route 1A Between:											
28SL	Logan Airport On-Ramp and Toll Plaza	2,880	1,750	13	5	N/A	N/A	N/A	N/A	F	F
29SL	Logan Airport Off- and On-Ramps	2,000	1,750	10	6	N/A	N/A	N/A	N/A	F	F
32SL	Neptune Road On- and Logan Airport Off-Ramps	2,830	2,530	44	10	--	--	--	--	C	F
34SL	Sumner Tunnel (Route 1A)	3,400	2,200	27	14	N/A	N/A	N/A	N/A	E	F

1. Numbers in left-hand column reference locations shown in Figure 3.3
2. In cases where LOS is shown to vary on individual highway links, the less favorable LOS measure reflects the impacts on traffic flow associated with weave maneuvers
3. N/A: Not Applicable

Source: Bechtel/Parsons Brinckerhoff

In the PM peak hour the entire Central Artery (in both directions) operates at LOS F, except for the southbound segments between the Callahan Tunnel and High Street off-ramps, which operate at LOS E. The Sumner Tunnel operates at LOS F due to severe congestion on the Central Artery northbound, while the Callahan Tunnel operates at LOS E. The Southeast Expressway also operates at LOS F from the East Berkeley Street on-ramp northward, in the northbound direction, and as far south as the Massachusetts Avenue interchange in the southbound direction.

Operating conditions on the local street system were examined at locations that are potentially sensitive to eventual project-related changes in traffic patterns. (The data, based on 1987 and 1988 ground counts, are reported in Table 3.3; locations are shown in Figure 3.4.) In most cases these data were used to calculate level of service using the methods recommended in the 1985 HCM.

Table 3.4 supplements Tables 3.2 and 3.3, presenting measures of traffic conditions on Central Artery/Southeast Expressway entrance ramps in cases where congestion is caused by constrained capacity on the ramps themselves or lane geometry at the ramp/mainline merge. On all other ramps, either operations are acceptable or ramp congestion is caused by constraints on the highway mainline or the local street system.

3.1.3(b) Operating Characteristics Of Traffic In Project Subareas
This section describes existing operating characteristics of traffic in five of the project subareas in the study area: Area North of Causeway Street, Central Area, I-93/I-90 Interchange and Massachusetts Avenue Interchange Area, South Boston, and East Boston/Logan Airport.

Area North Of Causeway Street. Operating conditions on the Central Artery north of Causeway Street are controlled by the Charles River high bridge. This bridge connects I-93 and the Tobin Bridge (Route 1) on the north side of the Charles River to the Central Artery and the Storrow Drive ramps on the south side of the Charles River. The bridge is approximately 700 feet long, with only three travel lanes in each direction. Both the length and width are insufficient to accommodate traffic demands and vehicular maneuvers. In the southbound (inbound) direction, traffic destined from Route 1 to Storrow Drive must weave across vehicles coming from I-93 continuing onto the Central Artery (inbound). In the northbound (outbound) direction, the reverse maneuvers occur. The northbound approach to the bridge is only two lanes, which creates a severe traffic bottleneck, causing long delays and queuing.

There are three complex at-grade interchanges that are critical in processing traffic through the Area North of Causeway Street: Leverett Circle in the West End, City Square in Charlestown, and the O'Brien Highway (old Charles River dam)/Gilmore Bridge intersection in East Cambridge. These locations are confluence points for several major arterials, each of which carries high volumes of vehicles.

- o Leverett Circle, the intersection of Storrow Drive and Nashua Streets, and the O'Brien Highway - This intersection connects ramps for the Central Artery to three roadways: Storrow Drive; the Charles River dam segment of the O'Brien Highway, which serves the arterial street systems of Cambridge and Somerville; and Nashua Street/Martha Way, which provides for arterial street access in the downtown Boston

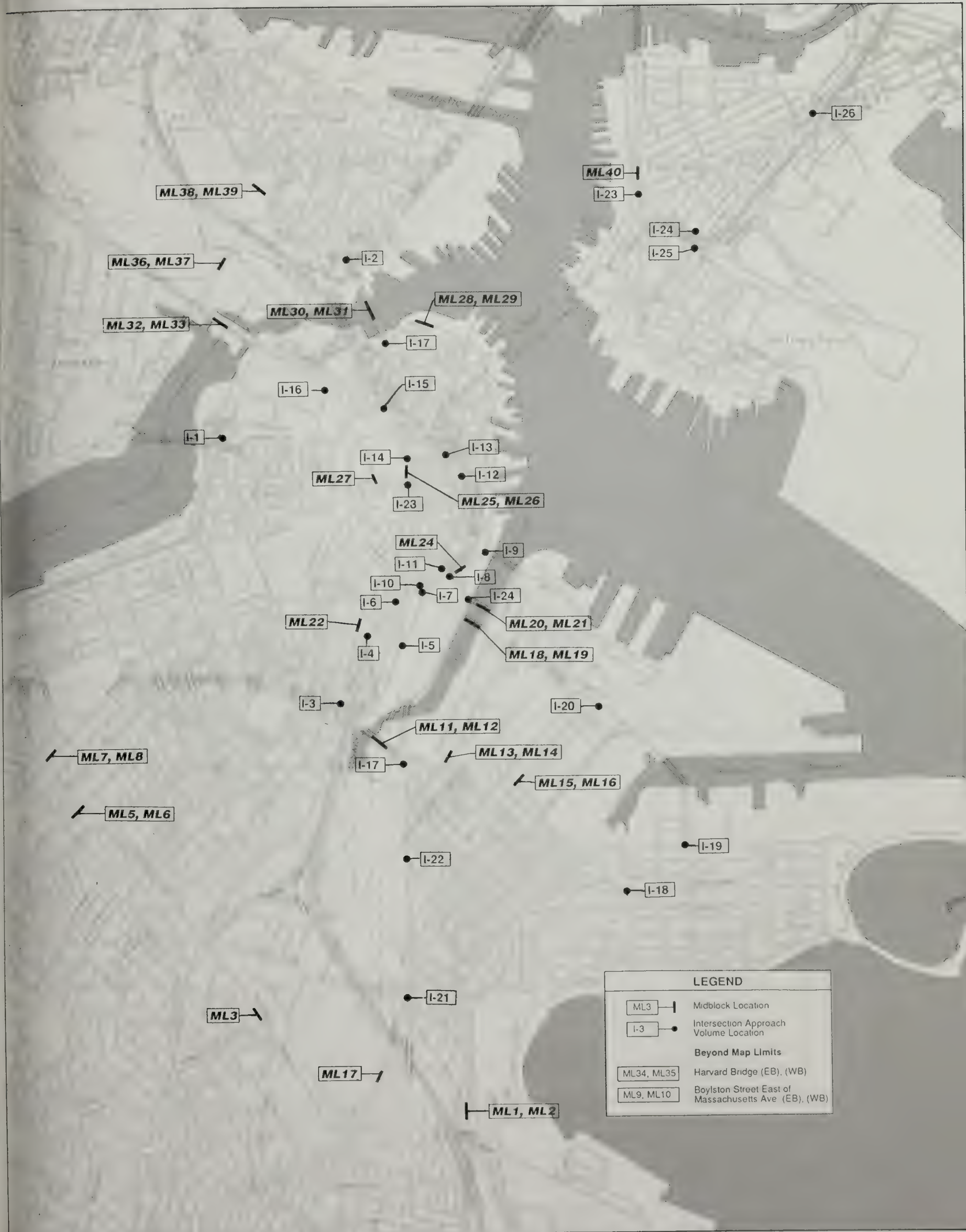


FIGURE 3.4

Local Traffic Operations - Existing

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

0 1000 2000 3000 4000 Feet

Table 3.3

1987/88 TRAFFIC CONDITIONS AT SIGNALIZED INTERSECTIONS

Location		Approach	Appr. Delay (Sec/Veh) AM	PM	Volume-to-Capacity Ratio AM[1]	PM[1]	Level of Service AM	PM
Area North of Causeway Street								
I-1	Leverett Circle	Charles River Dam EB	16.1	17.7	0.94/0.61	0.62/0.56	C	C
		Charles Street NB	24.3	>30.0	0.54/1.02/0.78	0.36/1.03/0.17	C	F
		Nashua SB	6.5	18.0	0.24	0.41	B	C
I-2	City Square (Chelsea/ North Washington)	Chelsea SB	40.6	27.6	1.02	0.63	E[2]	D
		North Washington NB	19.4	29.3	0.60/0.48	1.02/0.92	C	D
Central Area								
I-3	Herald/Albany/ West Broadway	Herald EB	19.0	24.6	0.72	0.90	C	C
		West Broadway WB	8.1	16.2	0.36	0.73/0.54	B	C
		Albany SB	13.4	17.0	0.61/0.50/0.24	0.83/0.50/0.16	B	C[2]
I-4	Kneeland/ Surface Artery	Kneeland EB	25.7	48.6	0.63	1.01/0.36	D	E
		Kneeland WB	11.3	6.6	0.08/0.25	0.98/0.44	B	D
		Surface Artery SB	27.4	33.9	0.95	1.01/0.36	D	D[2]
I-5	Kneeland/Atlantic	Kneeland EB	17.7	8.9	0.63/0.36	0.45/0.25	C	B
		Kneeland WB	15.6	15.6	0.02	0.02	C	C
		Atlantic NB	28.1	35.0	1.03/0.83	0.99/0.90	D[2]	D
I-6	Essex/Surface Artery	Essex EB	50.3	42.4	0.92/0.93	0.97	E	E
		Lincoln NB	31.7	27.6	0.95	0.75	D	D
		Surface Artery NB	29.7	24.6	0.57	0.65	D	C
		Surface Artery SB	20.6	21.8	0.76	0.83	C	C[2]
I-7	Atlantic/Summer	Summer EB	19.9	15.2	0.80/0.63	0.72/0.39	C	C
		Summer WB	40.5	25.9	0.32/0.91	0.51	E	D[2]
		Atlantic NB	57.3	47.5	1.03/1.03	1.01/0.67	E[2]	E[2]
I-8	Atlantic/Congress	Congress EB	15.6	25.6	0.85/0.60	0.72/0.88	C	D
		Congress WB	56.5	58.4	1.02	1.03	E	E
		Atlantic NB	50.6	29.4	1.01	0.84	E	D[2]
I-9	Atlantic/Northern	Northern WB	--	45.3	--	1.04	--	E
		Atlantic NB	--	37.7	--	0.82/1.02	--	D
I-10	Purchase/Summer	Summer EB	37.3	37.7	0.19	0.24	D	D
		Summer WB	16.8	13.1	0.37/0.44	0.43/0.31	C	B[2]
		Surface Artery NB	22.9	42.1	0.71	0.95	C	E
		Purchase SB	29.0	43.5	0.85/0.69	0.94/0.83	D	E[2]
I-11	Purchase/Congress	Congress EB	36.4	31.6	0.45/0.96	0.62/0.95	D	D[2]
		Purchase SB	19.3	19.4	0.44/0.37	0.85/0.64	B	C[2]
I-12	State/Surface Artery	State WB	27.6	14.8	0.85	0.43	D	B
		Surface Artery NB	13.2	18.7	0.42/0.59	1.00/0.69	B	C
		Surface Artery SB	20.9	33.6	0.71	0.93/0.45	C	D
I-14	State/Congress	State WB	27.6	24.5	0.77	0.59	D	C
		Congress NB	20.7	23.2	0.41	0.71	C	C
		Congress SB	14.3	11.0	0.36/0.76	0.35/0.46	B	B
I-13	Clinton/ Surface Artery	Clinton WB	24.9	45.0	0.50	0.94/0.49	C	E
		Surface Artery NB	15.3	24.3	0.86/0.41	0.41/0.99	C	C
		Surface Artery SB	44.1	19.1	1.00	0.35/0.77	E	C
I-15	New Chardon/Surface Artery	New Chardon WB	23.5	24.9	0.73	0.66	C	C
		Surface Artery NB	6.3	7.5	0.26/0.27	0.46	B	B
		Surface Artery SB	12.8	7.4	0.82	0.45	B	B
I-16	Lomasney/Causeway	Causeway EB	35.9	23.8	1.00/0.67	0.87	D	C
		Causeway WB	19.2	17.3	0.96/0.64	0.72	C	C
		Lomasney SB	37.0	14.8	0.98	0.41/0.58	D	B

Table 3.3 (Cont.)

1987/88 TRAFFIC CONDITIONS AT SIGNALIZED INTERSECTIONS

Location		Approach	Appr. Delay (Sec/Veh) AM	Appr. Delay (Sec/Veh) PM	Volume-to-Capacity Ratio AM[1]	Volume-to-Capacity Ratio PM[1]	Level of Service AM	Level of Service PM
South Boston								
I-17	Broadway/Dorchester	Broadway EB	6.4	6.0	0.85/0.51/0.48	0.09/0.53/0.68	B	B
		Broadway WB	17.0	24.1	0.83/0.64	0.93/0.63	C	C
		Dorchester NB	38.9	14.1	0.96/0.94	0.42/0.27	D	B
I-18	Broadway/I Street	Broadway EB	11.4	14.9	0.03/0.48	0.05/0.76	B	B
		Broadway WB	10.1	8.6	0.32	0.28	B	B
		I Street NB	52.9	17.1	1.03	0.65	E	C
		I Street SB	10.3	11.9	0.06/0.05	0.05/0.11	B	B
I-19	Summer/East First Streets	East First EB	15.5	15.2	0.37	0.33	C	C
		East First WB	15.9	14.6	0.26/0.49	0.18/0.28	C	B
		Summer NB	8.2	6.1	0.64	0.33	B	B
		Summer SB	6.5	8.6	0.49/0.26	0.67	B	B
I-20	Summer/D Streets	Summer EB	6.4	15.7	0.07/0.51/0.19	0.01/0.91/0.25	B	C
		Summer WB	7.7	8.6	0.62	0.57	B	B
		D Street NB	17.2	15.5	0.44/0.18	0.42/0.15	C	C
		D Street SB	15.3	13.8	0.03	0.05	C	B
I-21	Andrew Square	Southam EB	59.3	36.6	0.87/0.78	0.72/0.33	E	D
		Preble WB	39.5	27.3	0.75	0.33	D	D
		Dorchester Ave NB	34.6	35.0	0.20/0.89	0.89	D	D
		Dorchester Ave SB	29.4	38.5	0.78	0.94	D	C
		Boston NB	51.0	27.7	0.78/1.02	0.48/0.85	E	D
		Dorchester St SB	19.8	17.1	0.38	0.42	C	C
I-22	Old Colony/Dorchester	Dorchester EB	22.5	32.2	0.66	0.72	C	D
		Dorchester WB	22.0	43.2	0.70	0.85/0.68	C	E
		Old Colony NB	35.2	17.2	1.02	0.46/0.95	D	C
		Old Colony SB	7.7	12.1	0.32/0.57	0.85	B	B
East Boston/Logan Airport								
I-23	Central Square	Meridian EB	19.3	14.7	0.83	0.72	C	B
		Meridian WB	10.1	15.1	0.18/0.48	0.31/0.78	B	C
		Saratoga NB	14.4	15.3	0.02/0.06	0.24/0.05	B	C
		Saratoga SB	19.1	16.7	0.49	0.41	C	C
I-24	Chelsea/Visconti	Visconti WB	23.6	>60	0.66	0.54	C	F
		Chelsea NB	3.0	2.7	0.19/0.23	0.11/0.40	A	A
		Chelsea SB	18.7	>60	0.70	0.69	C	F
I-25	Harborside/Porter	Porter EB	12.6	9.5	0.39	0.72/0.32	B	B
		Porter WB	11.3	5.8	0.22	0.38	B	B
		Harborside NB	11.8	14.0	0.31	0.79	B	B
		Harborside SB	13.2	11.4	0.22/0.54/0.41	0.69/0.55/0.48	B	B
I-26	Neptune/Bennington	Neptune EB	18.7	14.3	0.24/0.19	0.26/0.16	C	B
		Neptune WB	46.0	38.9	1.01/0.53	1.01/0.71	E	D[2]
		Bennington NB	18.1	24.9	0.38	0.72	C	C
		Bennington SB	16.5	12.7	0.30/0.93	0.55	C	B

1. Multiple entries represent V/C ratios for different turning movements
2. Additional delays caused by downstream obstruction

Source: Bechtel/Parsons Brinckerhoff

Table 3.4

1987/88 TRAFFIC CONDITIONS IN RAMP AREAS

Location	Lane 1 Peak Hour Merge Volume (VPH)		Level of Service	
	AM	PM	AM	PM
Northbound				
Columbia Road on to Southeast Expressway	>2,000	1,690	F	D
East Berkeley Street on to Central Artery	>2,000	*	F	*
I-90 (Turnpike) on to Central Artery	>2,000	*	F	*
Congress Street on to Central Artery	1,990	*	E	*
Northern Avenue on to Central Artery	>2,000	*	F	*
Southbound				
Southampton Street on to Southeast Expressway	1,690	1,980	D	E
Massachusetts Avenue on to Southeast Expressway	1,630	N/A	D	N/A
Haymarket on to Central Artery	>2,000	*	F	*

1. * Ramp congestion at these times due to congestion on mainline not specific to this location
2. N/A: Not applicable

Source: Bechtel/Parsons Brinckerhoff

area. Currently, only the westbound connection to Storrow Drive is grade-separated; all other traffic movements must travel at-grade and pass through the signalized Leverett Circle rotary. Peak hour traffic volumes on these corridors are among the highest in downtown Boston. Traffic operations through Leverett Circle are highly congested. During the afternoon peak travel period, queues on all approaches, especially Charles Street/Storrow Drive, are long because of high demand and limited service capacity.

In Table 3.3, computed volume-to-capacity (V/C) ratios in the peak hour refer to vehicles counted in the middle of the rotary. Flow is further hindered, however, by intermittent queuing on the I-93 entrance ramp.

- City Square, the intersection of Chelsea Street and North Washington Street (the Charlestown Bridge) - While traffic operations at City Square are congested, i.e., within the LOS E-F range on individual approaches, no breakdown conditions are observed in the area, unless traffic leaving the intersection is obstructed by downstream queues originating at Keany Square across the Charlestown bridge. Conditions currently are highly variable, due to the effects of CANA project construction.

- Commercial Avenue/Gilmore Bridge/O'Brien Highway - Both the McGrath and O'Brien Highways (Route 28) and Rutherford Avenue-Gilmore Bridge are arterial routes used by vehicles bypassing I-93 southbound congestion. There are long queues and delays on the Gilmore Bridge approach during both peak travel periods.

Central Area. This segment of I-93 is located within downtown Boston. From Causeway Street to Kneeland Street, there are four on-ramps and five off-ramps in the southbound direction, and four on-ramps and four off-ramps in the northbound direction over a total distance of only 7,500 feet. In addition, the Storrow Drive on- and off-ramps to the Central Artery are positioned only some 1,600 feet from the Sumner/Callahan Tunnel on- and off-ramps, with another pair of on- and off-ramps to Causeway Street located between these major ramps. This results in multiple weaving and queue formations in both directions on the Central Artery. The adverse effects of multiple weaving maneuvers are compounded as the Central Artery descends into the Dewey Square tunnel, where horizontal curvature constrains traffic flow.

Further contributing to traffic congestion in the Central Area is the absence of a continuous north-south surface street system parallel to the Central Artery to distribute off-ramp traffic and collect on-ramp traffic. The analysis of at-grade intersections included in this SEIS/R concentrates on downtown locations near or along the existing Central and Surface Arteries, because these would be most affected by the proposed new alignment, in addition to locations providing access to key peripheral entry points (such as Northern Avenue and Congress and Summer Streets). In summary, of the 14 intersections examined in this subarea, 10 sites were found to be operating near or at capacity, i.e., LOS D to E, with some major queuing or congestion present on one or more of the individual intersection approaches. Surface street traffic operations are discussed below for major north-south arterials beneath the Central Artery and at Keany Square, a strategic intersection at the northern edge of the Central Area.

- o Atlantic Avenue - Traffic flow on Atlantic Avenue, along the east side of the Central Artery, is controlled by individually timed, interruptive traffic signals from Northern Avenue south to Kneeland Street. The northbound corridor has two to three through travel lanes, with curbside parking allowed in some areas. During the AM and PM peak periods, Atlantic Avenue operates at congested LOS D to LOS E due to high levels of vehicular demand, heavy opposing traffic flows, and, near South Station, heavy pedestrian crossing volume. Similar levels of congestion are experienced on the intersecting cross streets.

- o Surface Artery - This roadway essentially functions like an at-grade service road for the Central Artery south of the Callahan Tunnel. It provides for two to three travel lanes in each of the north- and southbound directions for much of its length. Purchase Street functions as a southbound extension of the under-Artery street between High and Summer Streets. All of the major intersections on the roadway are controlled by traffic signals, with traffic control police present at strategic locations during peak periods.

  Bottleneck locations on the Surface Artery and Atlantic Avenue corridors and intermittent queue spillback from Central Artery on-ramps delay Surface Artery motorists during the afternoon peak period. This is particularly true from Summer Street southward where volumes are high, and closely spaced signalized intersections limit coordination opportunities. It is this close proximity between signalized locations and the lack of sufficient storage space connecting them that frequently result in actual delays greater than those shown in Table 3.4.

- o Keany Square - This is the intersection of Causeway, Commercial, and North Washington Streets, another location of peak travel congestion. During the morning peak period, high vehicular demand on the Charlestown bridge (North Washington Street), most of which is bypassing I-93 congestion, results in long queues on the southbound approach.

I-93/I-90 Interchange And Massachusetts Avenue Interchange Area. The existing I-93/I-90 Interchange geometry is characterized by obsolete design standards with respect to curvature and inadequate spacings between successive ramps. Approximately 0.75 mile to the south of the major I-93/I-90 Interchange is a secondary interchange connecting the Southeast Expressway with Massachusetts Avenue and Melnea Cass Boulevard, both of which function as major crosstown arterials providing access to the South End/Roxbury areas and other points south.

During the morning peak period, high northbound volumes on the Southeast Expressway, coupled with the lack of auxiliary lanes between on- and off-ramps north of Southampton Street, result in congestion. During the evening peak period, the southbound three-lane expressway segment between the Massachusetts Avenue on- and off-ramps limits flow. Another factor contributing substantially to the expressway's travel problems is the Central Artery's queuing spillback onto the northbound Southeast Expressway. This condition prevents normal operations on the Southeast Expressway and, when increased vehicular volumes occur, causes the stop-and-go turbulence characteristic of LOS F.

South Boston. The South Boston portion of the project area does not have limited-access highways. Access to South Boston also is constrained by the limited number

of arterial connections to neighboring areas. Three bridges across Fort Point Channel (Northern Avenue, Congress Street, and Summer Street) provide the only access from the northern, predominantly industrial-commercial section of South Boston, to the downtown Central Business District, the Central Artery, and the Sumner/Callahan Tunnels. Access to the Massachusetts Turnpike is via one of these three bridges or the Broadway bridge, about 0.5 mile to the south of the Summer Street bridge, linked to northern South Boston by local streets.

The northern section of South Boston, with its concentration of industrial land uses, generates heavy volumes of truck traffic, which has poor access to the regional expressway system. This truck traffic, therefore, intrudes onto local streets that pass through residential areas.

During peak travel periods, many motorists bypassing Southeast Expressway congestion use South Boston minor arterial streets, such as A, D, I, C, and L Streets, to travel between southern points and downtown Boston. Northbound commuters and trucks enter South Boston via Southampton Street, Old Colony Avenue, Day Boulevard, and Dorchester Avenue. Northbound traffic during the AM peak hour generally does not result in intersection congestion, but is high enough to be objectionable on residential streets. Similar conditions are experienced in the southbound direction during the reverse PM peak hour, with the Fort Point Channel bridges serving as the key funnel points for outbound traffic from downtown.

East Boston/Logan Airport. This portion of the study area contains Logan Airport, which is the second-largest trip generator in the metropolitan area, after downtown Boston. Currently, most Sumner/Callahan Tunnel traffic is generated at Logan Airport, which also is served from the north by Route 1A.

Through a joint effort of the Massachusetts Department of Public Works (the Department) and the City of Boston, portions of the ramping system on Route 1A at the airport entrance have had restricted operations during peak traffic periods to facilitate access to/from the airport and to minimize travel on local East Boston streets. These actions have included routing Sumner Tunnel-bound traffic from Logan Airport onto Route 1A northbound and then southbound via a U-turn maneuver at Neptune Road, and the closing of the Neptune Road off-ramp. Recently, a "commercial vehicles (CV) only" lane has been established from the airport exit roadway to the Sumner Tunnel toll booths in order to give priority and "head of the line" privileges to multipassenger vehicles. Police details funded by Massport have been instrumental in making the CV lane work effectively. Traffic operating conditions at several strategic intersections within the tunnel and airport influence area have been subjected to detailed study for this SEIS/R. Both Neptune Road/Bennington Street and Chelsea Street/Visconti Street currently experience substantial congestion, with LOS F conditions in effect on two approaches at the latter intersection.

3.1.4 Truck Movements And Inflammable Cargo Routes

The percentages of trucks relative to total traffic volumes, averaged over segments of the study area, are shown below. These percentages are based on vehicle classification data drawn from several existing sources and updated with recent field counts taken for the project on arterials, expressways, and other highways in the study area. The figures incorporate light trucks (single-unit vehicles with more than four tires), heavy trucks

(tractor-trailer combinations with more than two axles), inflammable materials trucks, and buses.

- o Central Artery - 7.9%
- o East Boston - 6.7%
- o South Boston - 11.4%
- o Downtown - 5.1%
- o Charlestown - 7.3%

In South Boston, heavy trucks are forced to use congested local streets, some with residential uses, to get to the industrial area (generally north of First Street), because of weight restrictions on a number of bridges linking the area to the regional highway network. (Designated truck routes are illustrated in Figure 3.5.)

The distribution of truck trips by time of day and day of week conforms to the following basic patterns, as indicated by the recently collected count data.

- o There is relatively little variation in truck traffic flow among weekdays, with the exception of Friday. Friday truck traffic is significantly higher than other weekdays.
- o The peak hour for trucks usually is different than the peak hour for general traffic. On average, the AM truck peak hour occurs later than the general traffic peak hour.
- o In general, truck traffic peaks are less pronounced than general traffic peaks.
- o AM truck peak hour percentages are usually higher than PM peak hour truck percentages.

Vehicles carrying inflammable cargoes are prohibited from using the Callahan and Sumner Tunnels and the Dewey Square tunnel portion of the Central Artery. Because of this restriction, there are a number of alternative inflammable cargo routes through sections of the study area. (These routes are illustrated in Figure 3.6.)

In general, trucks carrying inflammable cargo represent a very low portion of total traffic. For example, along the Central Artery, trucks carrying inflammable cargo represent 3 one thousandths (or .003) of all traffic. The percentages of trucks carrying inflammable materials, relative to total truck volumes and to total traffic volumes, are shown below.

Weighted Averages (%) Of Inflammable Cargoes Relative To:	**Downtown**	**East Boston**	**South Boston**	**Portion Of Central Artery To Be Depressed**
Total Truck Volume	3.1	8.9	2.3	3.2
Total Traffic	0.3	0.8	0.3	0.3

The same percentages on key surface streets in the study area are shown in Table 3.5.

Table 3.5

INFLAMMABLE MATERIALS TRUCKS IN SELECTED LOCATIONS

Location	Direction of Travel	% of Total Truck Volume	% of Total Traffic Volume
Downtown			
1. Congress Street between State and North Streets	NB	0.31	0.03
	SB	0.54	0.04
East Boston*			
2. Meridian Street between Saratoga and Princeton	NB	1.10	0.09
	SB	1.56	0.09
3. Chelsea Street between Brooks and Putnam Streets	NB	3.57	0.22
	SB	0	0
4. Chelsea Street between Curtis and Chelsea River	NB	18.02	2.49
	SB	13.64	1.67
South Boston			
5. Dorchester Avenue between Southampton and D Streets	NB	2.24	0.40
	SB	3.15	0.98
6. West Broadway between E and F Streets	EB	1.11	0.07
	WB	1.39	0.10

1. * Routing of vehicles in East Boston carrying inflammable cargoes will not be affected by the project

Source: Bechtel/Parsons Brinckerhoff Field Survey, 1989

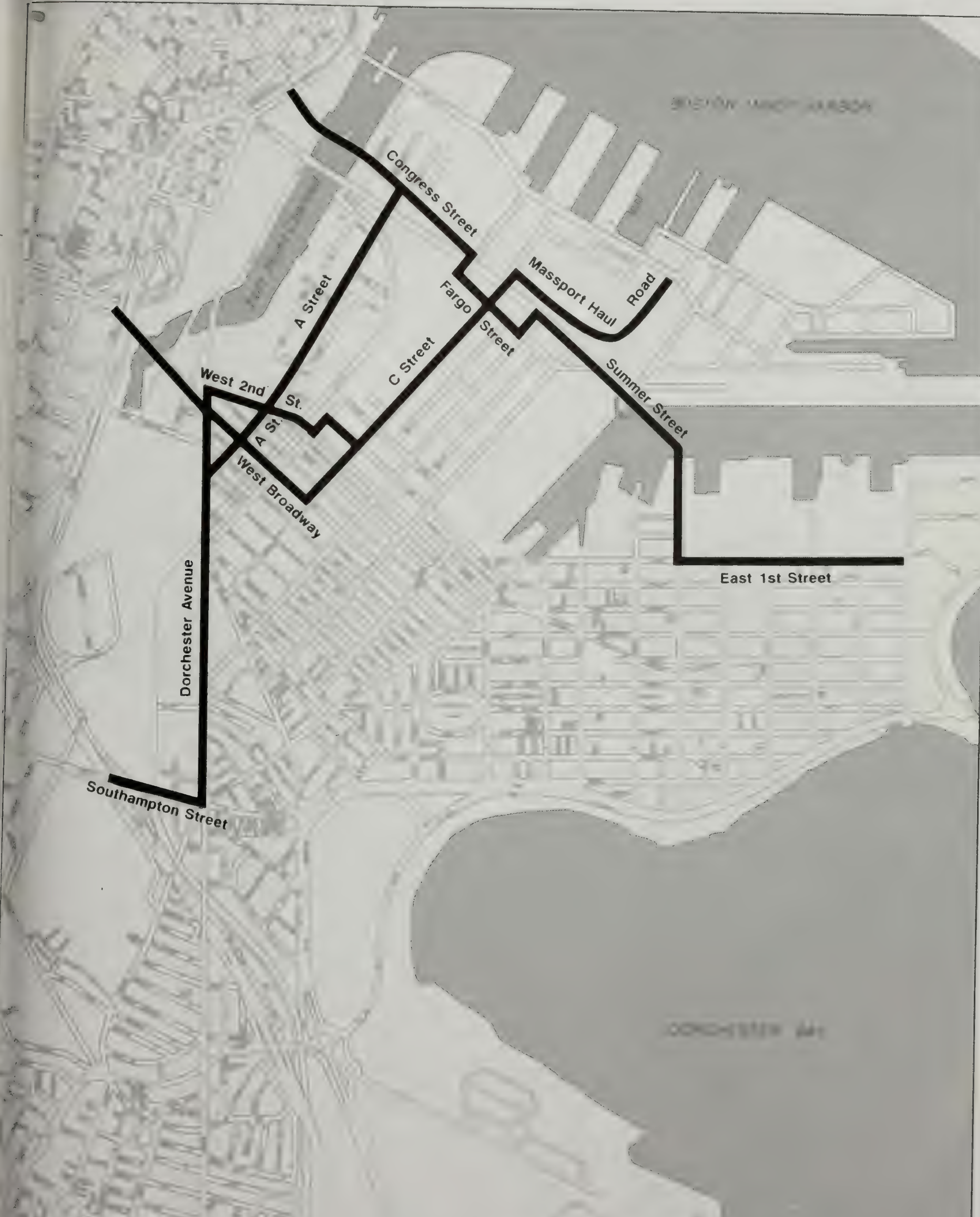


FIGURE 3.5

Existing South Boston Truck Routes 1990

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

0 1600 3200 4800 6400 Feet

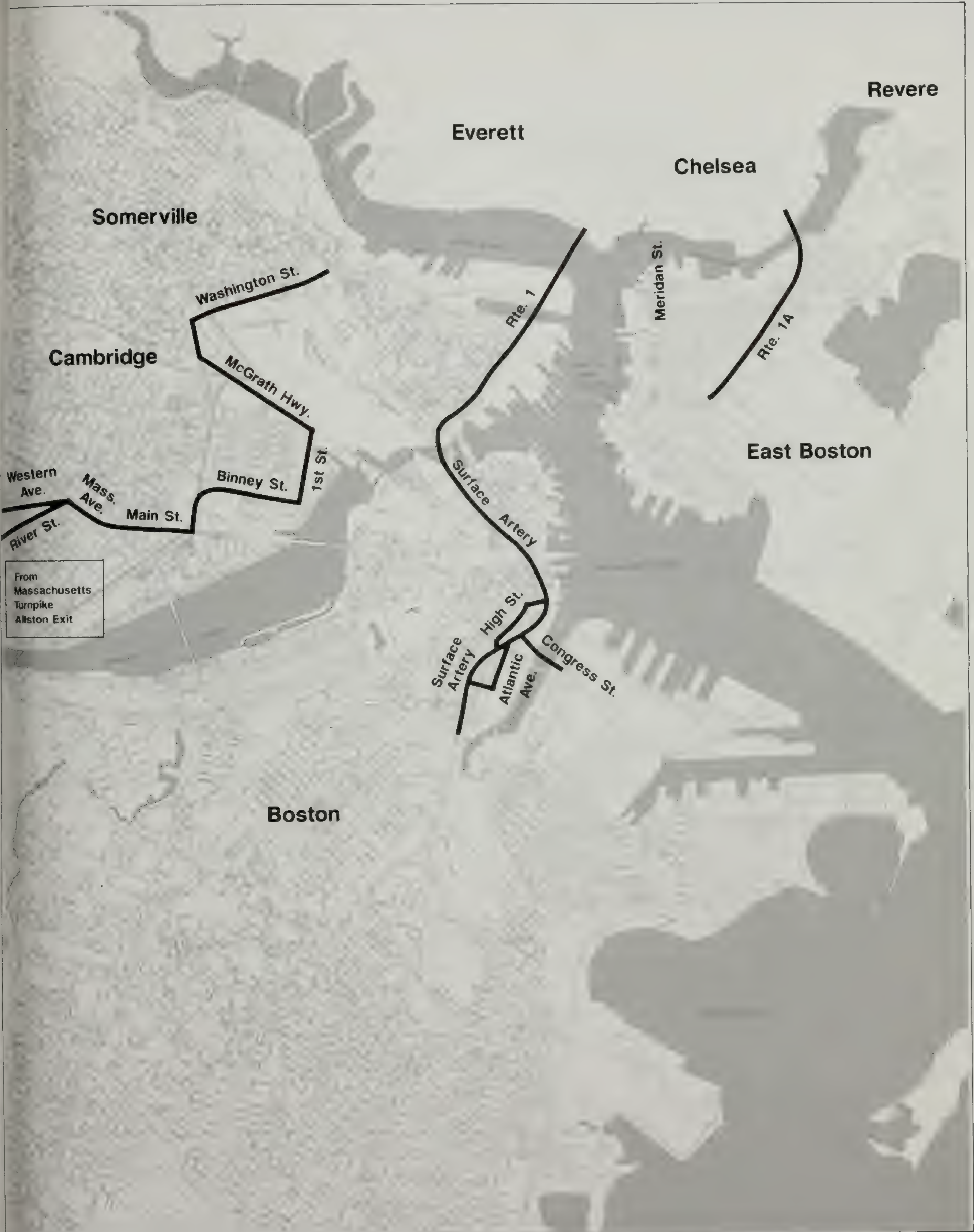


FIGURE 3.6

Inflammable Cargo Truck Routes

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

3.1.5 Parking Facilities

Within Boston Proper (bounded on the west and southwest by Massachusetts Avenue and Lenox Avenue, and on the southeast by Albany Street to Fort Point Channel) there is currently a total of approximately 68,000 legal parking spaces. Boston Proper has been subject to a Federally mandated parking freeze since 1976, limiting the supply of publicly available commercial parking to 35,503 spaces. A fall 1987 survey counted 55,667 off-street spaces -- 32,843 open to the public and 22,824 private. This was expected, at the time of the survey, to increase to 58,904 off-street spaces (34,318 public and 24,586 private) by the end of 1989. In comparison, the 1983 off-street parking supply consisted of 31,236 public and 18,109 private spaces, for a total of 49,345 off-street spaces. From 1983 through 1989, therefore, the total parking supply will have increased by 19.4 percent. Growth of the private parking supply, which is not subject to the freeze, has accounted for most of this increase. The 1989 supply of private spaces will be 36 percent higher than the 1983 supply.

In 1987, commercial parking rates varied widely, averaging $3.60 for 1 hour, $7.75 for 3 hours, and $10.00 for 8 hours. The average monthly rate was $186.00. These rates have increased 50 to 65 percent since 1983.

A large number of parking spaces are located along the construction corridor of the Artery/Tunnel Project. The corridor parking supply (in terms of both public and private spaces) by project subarea is as follows:

- Area North of Causeway - 1,938
- Central Area - 1,602
- I-93/I-90 Interchange Area - 3,713
- South Boston - 9,296
- East Boston - 6,339

It should be noted that the above figures represent the capacity of existing parking facilities, rather than project-related impacts, which are addressed in Section 3.2. (A complete inventory of parking spaces along the project corridor is provided in the Transportation Appendix.)

3.1.6 Safety

From 1982 through 1985, reported accidents occurred on the Central Artery at the rate of approximately 5.2 per million vehicle miles, which is approximately twice the national average for interstate highways. This rate is based on an average of 898 accidents each year (between two and three per day) between the Charles River and the I-93/Massachusetts Avenue interchange. Fatalities are relatively infrequent, however, because of the prevalence of congestion and slow-speed operations.

The high accident rate on the Central Artery is attributable primarily to features of the highway's design, in combination with usage characteristics. Constructed with State funding in the 1950s, the Central Artery has since been incorporated into the Interstate Highway System, but does not meet all interstate design standards.

Inclement weather and inordinately high traffic volumes are factors that compound the effects of design deficiencies. Nearly all of the existing I-93 facility is exposed to the

elements, and one-fourth of all accidents occur under conditions of fog, rain, sleet, or snow. Accident rates are also directly related to the intensity of roadway traffic. When traffic is operating at close headways, any incident can quickly involve other vehicles.

3.1.7 Public Transit

The rate of transit use in Boston is high relative to most cities in the United States. A 1988 report released by the U.S. Urban Mass Transportation Administration showed that Boston had the second-lowest percentage of single-passenger automobile work trips among 26 of the largest urbanized areas in the United States, with New York having the lowest. Accordingly, the percentage of workers using transit and carpools was second-highest. In the case of peak hour trips to the central business district (for all trip purposes), Boston had the third-highest percentage of transit use, after New York and Chicago.

3.1.7(a) Changes To The Public Transportation System

The Massachusetts Bay Transportation Authority (MBTA) has expanded and upgraded the study area's public transportation services, under a multiyear systemwide capital improvement program. The following is a summary of the major changes to the public transportation system since the FEIS/R:

- Opening of the northwest extension of the Red Line to Porter Square, Davis Square, and Alewife station
- Opening of new Red Line JFK/UMass station
- Extension of Red and Orange Line station platforms to accommodate six-car trains
- Track improvements to the Red and Orange Lines
- Acquisition of 58 new cars and rebuilding of Silverbird cars on the Red Line; acquisition of 90 new cars on the Green Line
- Relocation of the Orange Line south of Essex station to the Southwest Corridor
- Reinstatement of commuter rail service on the Needham Branch and the Fairmount Line
- Extension of commuter rail service on the Franklin Line to Forge Park/Route 495
- Relocation and reconstruction of commuter and Amtrak tracks at South Station; restoration of South Station headhouse
- Acquisition of 107 new cars and 26 locomotives on the commuter rail system
- Addition of 8,000 parking spaces at transit stations
- Introduction of the Hingham-Boston commuter boat service, Airport water shuttle, Charlestown Navy Yard shuttle (Massachusetts Department of Public Works), and privately operated commuter boat service between downtown Boston and Spinnaker Island

- o Introduction of remote parking/express bus services from Framingham and Quincy Adams stations to Logan Airport (Massport)

While the upgrading of the public transportation system has not eliminated congestion in the Boston metropolitan area, traffic conditions would be far worse in the absence of these improvements. Public transportation plays a critical role in relieving pressures on the overcrowded highway network, and maintaining mobility in the study area.

3.1.8 Air Transportation

In 1988, an estimated 23.6 million air passengers flew to or from Logan Airport. This represents growth of over 32 percent since 1983 and 90 percent since 1977. In 1988, there were approximately 68,000 passenger trips per day into and out of Logan Airport. Approximately 15,500 employees work at Logan Airport, 11,100 of whom travel to and from the airport on a typical weekday. Air cargo shipments increased in weight by 18 percent between 1983 and 1987: from 246,960 to 292,449 tons.

The Central Artery and Sumner/Callahan Tunnels are the airport's lifeline. Congestion-related delays on these facilities for trips to/from the airport have approximately doubled over the last 10 years. Severe congestion on the Central Artery obstructs traffic flow at the downtown portal of the Sumner Tunnel, causing long delays for airport travellers.

Airport-oriented ground traffic is a major component of total vehicular volumes in the Harbor tunnels and on the Chelsea Street and McArdle bridges. Over 50 percent of daily traffic through the Sumner and Callahan Tunnels is airport-related. During the PM peak hour, when congestion in the Sumner Tunnel is at its worst, approximately 70 percent of Sumner Tunnel traffic originates at Logan Airport. Airport-bound traffic also makes up a major component of Central Artery traffic. For example, in the southbound artery segment immediately south of the Sumner Tunnel, 20 percent of PM peak hour traffic is from the airport. Over 24 hours, 14.3 percent of this traffic is from the airport. On the Charles River high bridge, which is the single worst bottleneck in the regional highway system, airport traffic constitutes 13.3 percent of northbound total traffic and 7.7 percent of southbound total traffic in the PM peak hour.

In response to the increasingly severe traffic congestion in the tunnels and on the Central Artery, Massport has vigorously promoted alternatives to the private automobile for airport ground access. This program has produced significant results. In 1987, the percentage of air passengers using modes other than private or rental car was approximately 42 percent, compared to the 32 percent nonauto mode share in 1984.

3.1.9 Pedestrian Circulation

Boston has long been pedestrian-oriented, as compared to other U.S. cities. The existence of several dense residential neighborhoods interspersed throughout the Central Business District reinforces this condition. In recent decades, City Hall Plaza, Faneuil Hall Marketplace, the Downtown Crossing Auto Restricted Zone, the Freedom Trail, and Harborpark have provided enhanced pedestrian amenities in the central parts of the study area. Along the Charles River new pedestrian routes are planned with a proposed extension of open space

between the O'Brien Highway and the new Charles River dam. Currently, east-west movement is not possible along either bank of the river, as no continuous path exists. The Charles River dam, to the east of the Central Artery, is used by some pedestrians crossing from Boston to Charlestown.

Approximately 25 to 30 percent of residents who live in the study area are estimated to walk to work, and 35 to 40 percent of other trips by these residents are on foot, according to project-sponsored traffic studies. In addition, these studies indicate that half of school- and nonhome-based trips in the study area are made by walking. Pedestrian flows often can be intense, particularly around transit stations.

Over 20 major pedestrian crossings of the Central Artery corridor have been identified; those used by commuters are concentrated in three areas: Dewey Square, Rowes Wharf, and North Station. Almost 4,300 people were counted crossing Dewey Square during the morning peak hour in November 1988. Tourist traffic is concentrated at Congress Street, Aquarium Wharf, Faneuil Hall-Long Wharf, North Street, Hanover Street, and North Washington Street. Nine crossings are used heavily by shoppers, residents, and downtown workers at lunchtime. The Freedom Trail, a walking route linking many of the City's Revolutionary Period historic sites, crosses the Central Artery at the Haymarket-North End walkway. The Freedom Trail has been a unit of the National Recreation Trail System since 1976, and is administered by the Freedom Trail Commission in cooperation with the Boston National Historic Park. The trail connects some 16 historical features in its 3-mile length and is used by approximately 4 million visitors each year.

A comprehensive program of documenting pedestrian activity will begin in the spring of 1990. This program will include recording pedestrian volumes at approximately 40 locations throughout the Central Artery corridor. Surveys will be underway over the course of 2 to 3 years to account for seasonal changes. The results of these counts and studies of pedestrian behavior will provide necessary background information for construction period mitigation measures and for final design of pedestrian amenities.

3.1.10 Bicycling

According to the most recent available counts, conducted in the early 1980s, approximately 2,000 cyclists commute to or from work in downtown Boston. These counts suggest that bicycling is more heavily concentrated away from the downtown area, particularly along the Massachusetts Avenue corridor between the Back Bay and Cambridge and around Boston University and the Harvard Square area.

The Boston Bikemap, prepared by the Boston Metropolitan Planning Organization, identifies a bikeway network of relatively unpolluted streets with low vehicular volumes, that is favored by hundreds of local cyclists. It indicates that heavy use is not made of the Central Artery corridor. Instead, the alternatives are Commercial Street/Atlantic Avenue and zigzagging paths through the North End, both of which can continue southward along Dorchester Avenue or A Street in the Fort Point Channel area. Some use of Summer Street and West Second Street/Broadway in the residential sections of South Boston also is indicated. Bikepath crossings of the Central Artery occur at Causeway, Commercial and Milk Streets, and the base of State Street.

3.2 ENVIRONMENTAL CONSEQUENCES

3.2.1 Summary Of Project Transportation Impacts

The Artery/Tunnel Project will have overall beneficial transportation impacts in every part of the study area. The project will provide a substantial expansion of capacity on the system of limited-access highways in the core of the Boston metropolitan area. As a result, these highways will carry increased traffic volumes and a greater share of total vehicular traffic. The increase in traffic on limited-access highways will result primarily from the diversion of vehicles away from parallel routes. In almost every section of the study area, the diversion of commuters and other motorists onto the expressway system will result in improved traffic operations on local streets. (There are a few specific locations at which the relocation of ramps will cause a localized redistribution of vehicles that is expected to affect traffic conditions adversely in that immediate vicinity. On the vast majority of local roadways in the study area, however, the impact of the project will be to lower vehicular volumes and improve traffic flow.)

While the expressway system will carry increased traffic volumes, the quality of traffic operations on these limited-access highways also will improve. On the new Central Artery, which will carry between 10 and 75 percent more peak hour traffic at its peak load points, depending on the direction of travel and time of day, peak hour travel speeds will increase substantially, relative to future conditions without the project. Despite the large increase in total peak hour traffic volumes, the Artery will carry 29 percent fewer vehicles per lane on a daily basis -- 21,200 versus an average of 30,000 if the roadway were not reconstructed. It is these lower per lane traffic volumes that will result in reduced congestion and improved travel speeds.

The duration of traffic congestion also will be reduced markedly and the severity of that congestion will lessen significantly. Whereas congestion on various segments of I-93 and Route 1 in the year 2010 is projected to last from 9 to 14 hours per day without the project, the duration of congestion at the same locations will be reduced to only 1 to 4 hours with the reconstructed Central Artery and new Third Harbor Tunnel in place. At both the I-93 and Route 1 southbound approaches to the Charles River bridge, congestion will decrease from 14 hours in the 2010 baseline to only 1 hour under the Proposed Action. On the Central Artery northbound, approaching the Charles River bridge, 11 hours of congestion are forecast for the 2010 baseline condition, whereas the Proposed Action will reduce congested operations to 4 hours per day. In the Callahan and Sumner Tunnels, congested operations will decline to 2 hours and 1 hour, respectively, with the Proposed Action in place, from 9 and 10 hours in the 2010 baseline condition.

The project will provide a major improvement in ground access to Logan Airport, the operation of which would be impaired severely in the absence of the new tunnel and expansion of Central Artery capacity. Existing access problems on the routes leading to and from the airport would be compounded in 2010 with substantial growth in air travel and other sources of ground traffic, such that the airport could no longer fulfill its vital role in the regional economy.

The project not only will provide for a necessary expansion of total airport ground access capacity, but also a more efficient access system, through its provision of high-occupancy vehicle (HOV) lanes. The increased use of high-occupancy modes is critical to the airport's

ability to accommodate future traffic demands. The project's HOV system will help produce a higher proportion of bus and multipassenger vehicle trips, not only to and from the airport, but also to and from downtown Boston. The South Boston Bypass Road is a critical link in the HOV system, and also will improve truck access to the airport, South Boston and East Boston, in the process removing trucks from local streets.

Table 3.6 summarizes some of the major impacts of the project in the year 2010, compared both to conditions in 2010 without the project -- the 2010 baseline -- and existing conditions. As a result of the project, average network speeds in 2010 are estimated to be 44 percent higher on a daily basis and 57 percent higher in the PM peak hour than they would be if the project were not built. (The network includes most roadways in the project study area, as defined in Section 3.1.) In the downtown area, the Proposed Action will cause operating speeds in the roadway network (including local streets) to increase by 94 percent on a 24-hour basis, and by an even greater margin in the PM peak hour. Additional impacts shown in the table include a 3 percent increase in the number of vehicle miles travelled (VMT) throughout the study area, at the same time that vehicle hours travelled (VHT) will be reduced by 29 percent. The small change in VMT results from the rerouting of vehicle trips onto the study area's limited-access highway system. The substantial reduction in VHT results from improved travel speeds throughout the study area on both expressways and local roadways. On local streets and arterials, average weekday VMT will decrease 18 percent, and VHT will decrease by 34 percent, reflecting the diversion of vehicles away from City streets.

The table further shows that the Proposed Action will result in improved traffic operating conditions on the expressway system and at local roadway intersections, as measured in terms of level of service (LOS) indicators. Without the project, 87 percent of the expressway links in the core of the study area would operate during the PM peak hour at highly congested LOS F conditions. With the Proposed Action in place, however, the number of LOS F highway segments in the PM peak hour will be reduced to 21 percent. Among 29 comparable strategic intersections (selected on the basis of potential sensitivity to project-related impacts), 12 to 13 would operate with one or more approaches at LOS F during the AM and PM peak hours, respectively, without the project. As a result of the Proposed Action, however, the number of intersections with one or more approaches at LOS F will be reduced to 7 and 8, in the AM and PM peak hours, respectively.

It is clear that even with the massive improvements represented by the Central Artery and Third Harbor Tunnel in place, traffic will not flow unimpeded in the year 2010 at all places and at all times. Activity in the Boston metropolitan area will continue to expand independently of the project, and transportation requirements increase accordingly. A corollary is that, if the Proposed Action is not implemented, the traffic circulation system that has helped support a vital and burgeoning central Boston will become dysfunctional.

3.2.2 Transportation Analysis Methodology

Throughout this section, transportation impacts associated with the Artery/Tunnel Project are identified in comparison with future conditions without the project; the latter case is referred to as the 2010 baseline condition. The Proposed Action and 2010 baseline are defined further as follows:

Table 3.6

SUMMARY OF EXISTING AND PROJECTED TRAFFIC CONDITIONS

	Existing	2010 Baseline	2010 Proposed Action
Average Daily Network Speed			
Study Area	14.5	10.4	15.0
Downtown Boston	12.8	8.3	16.1
AM Peak Hour Speed			
Study Area	11.9	10.3	10.7
Downtown Boston	12.1	9.6	12.4
PM Peak Hour Speed			
Study Area	14.5	10.4	15.0
Downtown Boston	12.8	8.3	16.1
Daily Vehicles Miles Travelled (VMT)	3,880,600	5,120,000	5,278,800
Daily Vehicle Hours Travelled (VHT)	267,400	492,617	351,300
Daily Cordon Count[1] (Study Area Core)	1,116,000[2]	1,338,100[2]	1,436,400[2]
Percent of LOS F Highway Links[2]			
AM Peak Hour:	43.0%	66.0%	40.0%
PM Peak Hour:	63.0%	87.0%	21.0%
Intersections with one or more approaches at LOS F[3]			
AM Peak Hour:	0	12	7
PM Peak Hour:	2	13	8

1. Cordon Lines: Massachusetts Avenue, Charles River, Mystic River/Boston Harbor
2. Inbound and outbound trips
3. I-90/I-93 and other major highway links inside the study area
4. Of the selected number of intersections (29) chosen for comparative analysis

Source: Bechtel/Parsons Brinckerhoff

- o The 2010 baseline: describes what traffic conditions would be like in the study area if all the major established trends continue and no significant ameliorative actions are taken; it defines a solid baseline against which the positive and negative effects of the Proposed Action can be evaluated. (In many EIS documents for other projects this set of forecasts if referred to as the no build scenario.) This comparison isolates the impacts that are specifically related to the Proposed Action, as opposed to changes that would occur in the future as a consequence of other factors.

- o The 2010 Build condition: is a forecast of the traffic and transportation loads and behavior on all segments of the network with the Proposed Action in place.

The 2010 baseline roadway network is assumed to remain largely unchanged from existing conditions, with the exception of certain specific modifications, including the CANA project and a relocated Northern Avenue bridge. A number of additional modifications to the roadway network were assumed in forecasting traffic conditions with the Proposed Action in place. These consisted primarily of changes in street directions consistent with the relocation of certain ramps. A detailed description of the roadway network changes associated with both the 2010 baseline and Proposed Action conditions is provided in the Transportation Appendix.

This section examines all the relevant elements and behavioral features of traffic operations. These include: a comparison of current (1987/88) and projected future daily and peak hour volumes; and an analysis of existing and future traffic operations (including travel times, hours of congestion, vehicle miles and hours of travel, truck traffic, safety considerations, and replacement parking). The discussion of other transportation facilities covers public transit (MBTA rapid transit and commuter rail facilities, buses, and waterborne transportation), air transportation, and pedestrian circulation.

(The underlying assumptions and procedures used to develop the traffic forecasts are described in the technical report Detailed Travel Model Documentation, June 1989. An overview of the forecasting process is shown in Figure 3.7. It can be seen that the process is a complex one, involving 20 different steps or modules, each of which is described and discussed in the technical report.)

Assigning the future volumes of vehicles to be expected throughout the study area highway network is the culmination of the forecasting process. This, then, leads to further traffic operational and environmental investigations (for example, capacity constraints, potential queuing conditions, unsafe overloads, air pollution and noise generation impacts, and the need for adjustments and mitigation measures). The assignment of traffic to individual roadway links in the study area was accomplished through use of an elaborate computerized model (TRANPLAN) that is one of the most advanced versions of such standard tools for the nation. Traffic operational characteristics at specific locations were analyzed through micro-level methods that could provide the detail and precision necessary to calculate project-related impacts. In addition, manual procedures also were utilized where appropriate as "reasonableness" checks, that is, professional and common sense assurances that the results are in proper scale and internally consistent.

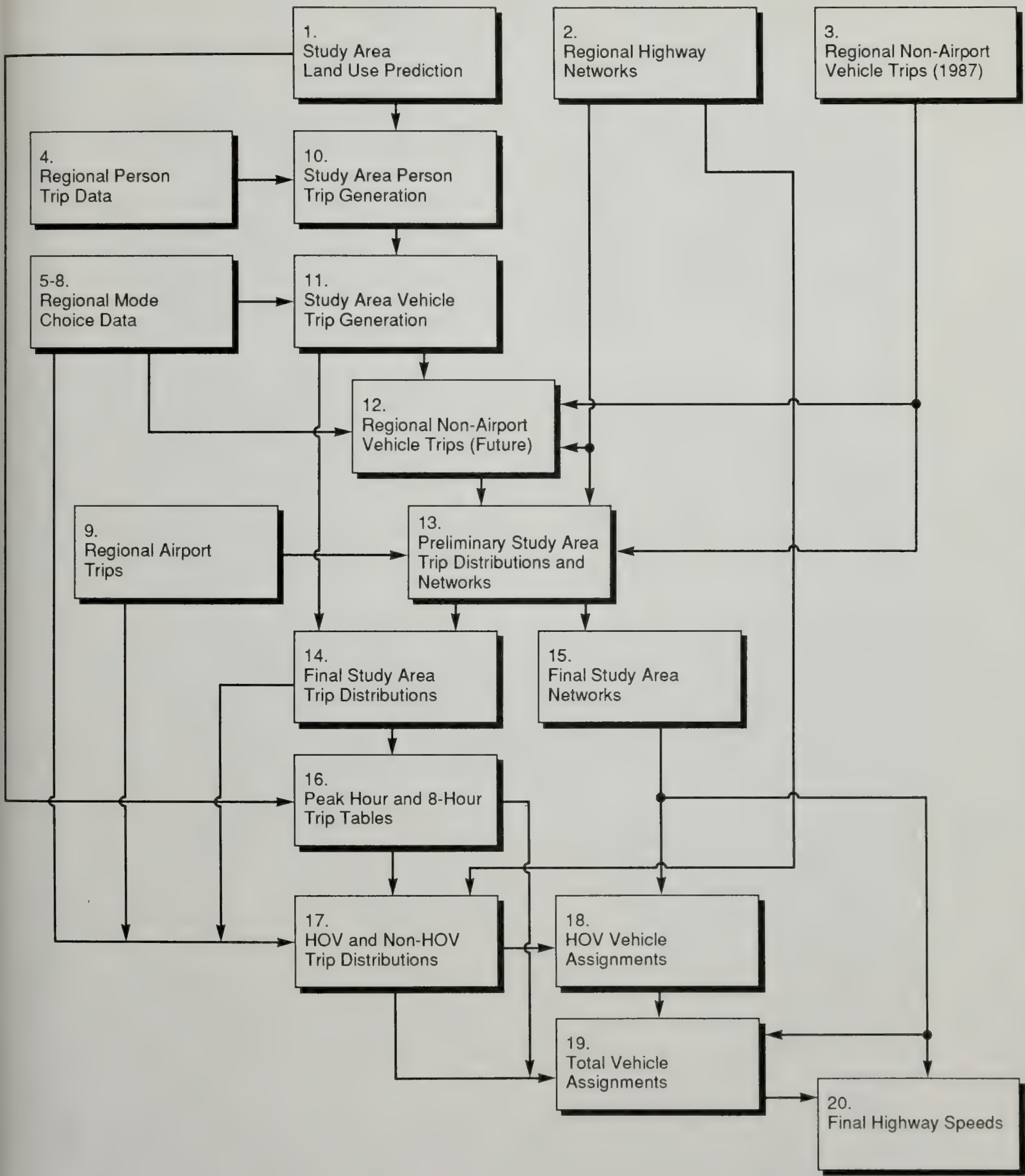


FIGURE 3.7 **Structure Of The Forecasting Process**

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

3.2.3 Projected Traffic Volumes

3.2.3(a) Trips Entering And Leaving The Core Of The Study Area

A total of 666,500 inbound and 671,600 outbound daily trips would enter and leave the core of the study area in the 2010 baseline case (see Figure 3.8). This represents an increase of 19 and 21 percent respectively over existing conditions. The Proposed Action will increase the volumes of entering and exiting traffic relative to the 2010 baseline by 7 percent, to 715,700 inbound and 720,700 outbound vehicles per day (see Figure 3.9). The small percentage of additional trips in the Proposed Action case result from the increased use of the expressway system, particularly the Central Artery, Seaport Access Road, and Third Harbor Tunnel, by vehicles that otherwise would be travelling on other roadways outside the section of the study area bounded by the cordon lines.

3.2.3(b) Daily Traffic Volumes

As a result of the expansion of highway capacity made possible by the Proposed Action, daily traffic volumes will increase on the expressway system and decrease on local roadways. In addition to the widening of the Central Artery, Proposed Action changes in the network that will alter future baseline traffic patterns include the elimination and relocation of Central Artery exits and entrances, the Third Harbor Tunnel, the eastern extension of I-90, and the South Boston Bypass Road. Each of these changes will provide many Boston motorists with alternate paths that, in many cases, will be faster than their present routes to their destinations.

Traffic volumes are forecast to average 221,100 vehicles per day along the Central Artery (including major parallel ramps) between Kneeland and Causeway Streets for the Proposed Action, versus 178,800 vehicles per day for the 2010 baseline, an increase of approximately 24 percent. The Third Harbor Tunnel will carry 96,900 vehicles per day. This large increase in traffic volumes carried on the expressway system will occur primarily as a result of a substantial diversion of traffic away from local streets, as described below.

Table 3.7 compares AWDT in the 1987/88 existing case, the 2010 future baseline case and the 2010 Proposed Action for highway links and ramps. (Note that Table 3.1 in Section 3.1.2 compared 1987/88 and 1982 two-way AWDT volumes, whereas 1987/88 volumes in Table 3.7 are listed separately by direction and are compared to estimated 2010 traffic volumes. Table 3.2 in Section 3.1.2 presented 1987/88 AM and PM traffic volumes and operating characteristics.) Existing and 2010 baseline locations referenced in Table 3.7 are shown in Figure 3.3; Proposed Action locations are shown in Figures 3.10 through 3.15. Although peak hour volumes are the determining factors of how much congestion and delay is likely to be experienced by motorists going to and from work, AWDT volumes provide a better measure of the overall use of a given roadway, and changes in use over time or between different highway system configurations.

Whereas traffic volumes on the Central Artery will increase substantially as a result of the Proposed Action, the number of vehicles using several other existing expressway facilities will decline. The table shows that daily traffic volumes would increase between 1987 and the 2010 baseline condition by 11 percent in the Callahan Tunnel and 8 percent in the Sumner Tunnel. The Proposed Action, however, will cause volumes in both the Callahan and Sumner Tunnels to decline substantially relative to both the 2010 baseline and 1987 conditions, because the Third Harbor Tunnel will carry a large share of traffic to and from Logan

Table 3.7

EXISTING AND PROJECTED AVERAGE WEEKDAY TRAFFIC VOLUMES

Highway Links[1]		1987/88 Existing	2010 Future Baseline	2010 Proposed Action
Northbound Links				
Southeast Expressway Between:				
NL1	Columbia Road Off- and On-Ramps	80,000	98,400	89,800
NL2	Columbia Road On- and Southampton Street Off-Ramps	94,000	114,200	110,700
NL3	Massachusetts Avenue and East Berkeley Street On-Ramps	67,000	86,900	N/A
NL4	Massachusetts Avenue and I-90 WB/Broadway Off-Ramps	N/A	N/A	93,900
NL5	I-90 WB/Broadway Off- and Massachusetts Avenue On-Ramps	N/A	N/A	55,600
NL6	Massachusetts Avenue On- and Third Harbor Tunnel (I-90 EB) Off-Ramps	N/A	N/A	74,100
NL7	East Berkeley Street On- and I-90/Kneeland Street Off-Ramps	83,000	92,200	N/A
NL8	I-90/Kneeland Street Off- and I-90/Broadway On-Ramps	55,000	77,700	N/A
NL9	I-90 EB Off- and I-90 WB On-Ramps	N/A	N/A	53,500
NL10	I-90 WB and I-90 EB/Broadway On-Ramps	N/A	N/A	58,500
Central Artery Between:				
NL11	South Street On- and Northern Avenue Off-Ramps	93,000	102,800	N/A
NL12	I-90 EB/Broadway On- and North Street Off-Ramps	N/A	N/A	119,700
NL13	Northern Avenue On- and Callahan Tunnel Off-Ramps	99,000	111,700	N/A
NL14	Callahan Tunnel Off- and Sumner Tunnel On-Ramps	73,500	75,400	N/A
NL15	North Street Off- and Essex Street/Northern Avenue On-Ramps	N/A	N/A	91,700
NL16	Essex Street/Northern Avenue and Sumner Tunnel On-Ramps	N/A	N/A	91,700
NL17	Sumner Tunnel On- and Causeway Street Off-Ramps	99,000	105,000	N/A
NL18	Sumner Tunnel On- and Route 1 Off-Ramps	N/A	N/A	105,600
NL19	Storrow Drive Off- and On-Ramps	60,000	66,500	N/A
NL20	Storrow Drive On- and Route 1 (Tobin Bridge) Off-Ramps	92,000	104,200	N/A
NL21	Valenti Way/City Square and Leverett Circle On-Ramps	N/A	N/A	67,200

Table 3.7 (Cont.)

EXISTING AND PROJECTED
AVERAGE WEEKDAY TRAFFIC VOLUMES

Highway Links		1987/88 Existing	2010 Future Baseline	2010 Proposed Action
NL22	I-93 Between Route 1 On-Ramps	52,000	53,500	46,800
NL23	I-93 North of Route 1 Interchange	60,000	65,600	84,100
NL24	Route 1 North of I-93 Ramps	52,000	61,900	61,200
Route 1A Between:				
NL25	Toll Plaza and Logan Airport Off-Ramp	44,000	52,100	35,700
NL26	Logan Airport On- and Neptune Road Off-Ramps	30,000	42,400	N/A
NL27	I-90 EB (Third Harbor Tunnel) On- and Neptune Road Off-Ramps	N/A	N/A	43,000
NL28	Route 1A North of Neptune Road Off-Ramp	20,000	26,100	32,000
NL29	Callahan Tunnel	52,000	57,800	39,100
Southbound Links				
Southeast Expressway Between:				
SL1	Southampton Street On- and Columbia Road Off-Ramps	96,000	105,000	112,900
SL2	Boston Street Off- and Southampton Street/ Massachusetts Avenue On-Ramps	N/A	N/A	91,000
SL3	Boston Street Off- and Southampton Street On-Ramps	91,000	86,600	N/A
SL4	Massachusetts Avenue On- and Boston Street Off-Ramps	101,000	101,100	N/A
SL5	Massachusetts Avenue and Boston Street Off-Ramps	N/A	N/A	97,600
SL6	Massachusetts Avenue Off- and On-Ramps	88,000	83,700	N/A
SL7	East Berkeley/Albany Streets On- and Massachusetts Avenue Off-Ramps	100,500	102,400	N/A
SL8	I-90 WB On- and Massachusetts Avenue Off-Ramps	N/A	N/A	122,300
SL9	East Barrel between Essex Street On-Ramp and Central Artery West Barrel	N/A	N/A	49,100

Table 3.7 (Cont.)

EXISTING AND PROJECTED AVERAGE WEEKDAY TRAFFIC VOLUMES

Highway Links		1987/88 Existing	2010 Future Baseline	2010 Proposed Action
SL10	West Barrel between Congress Street On- and I-90 WB/Albany Street Off-Ramps	N/A	N/A	63,000
Central Artery Between:				
SL11	I-90/Kneeland On- and East Berkeley Street Off-Ramps	87,000	79,300	N/A
SL12	I-90 EB/Kneeland Street and I-90 WB On-Ramps	N/A	N/A	92,400
SL13	Beach Street and I-90/Broadway Off-Ramps	87,000	85,800	N/A
SL14	Congress Street On- and Beach Street Off-Ramps	94,000	98,500	N/A
SL15	Purchase Street On- and Dewey Square (Summer Street) Off-Ramps	92,000	96,000	N/A
SL16	Oliver Street and Dewey Square (Summer Street) Off-Ramps	N/A	N/A	99,400
SL17	Haymarket On- and High Street Off-Ramps	90,000	100,200	N/A
SL18	New Chardon Street On- and Oliver Street Off-Ramps	N/A	N/A	115,300
SL19	Callahan Tunnel Off- and Haymarket On-Ramps	66,000	75,000	N/A
SL20	Causeway Street On- and Callahan Tunnel Off-Ramps	92,000	98,800	N/A
SL21	Leverett Circle On- and Callahan Tunnel/ Clinton Street Off-Ramps	N/A	N/A	123,600
SL22	Leverett Circle On- and Haymarket Off-Ramps	86,000	92,700	N/A
SL23	Route 1 SB (Tobin Bridge) On- and Leverett Circle Off-Ramps	87,000	104,400	N/A
SL24	Route 1 SB (Tobin Bridge) and Leverett Circle On-Ramps	N/A	N/A	100,000
SL25	I-93 Between Route 1 Ramps	50,500	49,900	59,400
SL26	I-93 North of Tobin Bridge Ramps	62,500	64,300	91,000
SL27	Route 1 North of I-93 Ramps	44,000	58,300	55,500
Route 1A Between:				
SL28	Logan Airport On-Ramp and Toll Plaza	37,000	46,100	32,000
SL29	Logan Airport Off- and On-Ramps	11,000	19,000	14,100

Table 3.7 (Cont.)

EXISTING AND PROJECTED AVERAGE WEEKDAY TRAFFIC VOLUMES

Highway Links		1987/88 Existing	2010 Future Baseline	2010 Proposed Action
SL30	I-90 WB (Third Harbor Tunnel) and Logan Airport Off-Ramps	N/A	N/A	26,200
SL31	Neptune Road On- and I-90 WB (Third Harbor Tunnel) Off-Ramps	N/A	N/A	48,600
SL32	Neptune Road On- and Logan Airport Off-Ramps	23,000	37,900	N/A
SL33	Route 1A North of Neptune Road On-Ramp	30,500	22,900	31,600
SL34	Sumner Tunnel (Route 1A)	47,000	50,700	39,000
Eastbound Links				
EL1	Storrow Drive West of Copley Square Ramps	53,500	59,000	55,100
EL2	Massachusetts Turnpike (I-90) West of I-93 Ramps	42,000	59,900	62,900
I-90 Between:				
EL3	I-93 On- and Congress Street Off-Ramps	N/A	N/A	44,700
EL4	Congress Street and I-90 C/D On-Ramps	N/A	N/A	40,900
EL5	Third Harbor Tunnel (I-90 C/D On- to Logan Airport Off-Ramps)	N/A	N/A	49,300
EL6	Logan Airport Off-Ramp to Route 1A	N/A	N/A	26,600
I-90 C/D Between:				
EL7	Albany Street On- and Massport Haul Road Off-Ramps	N/A	N/A	21,700
EL8	Massport Haul Road Off-Ramp and Merge to I-90 Mainline	N/A	N/A	8,400
Westbound Links				
WL1	Storrow Drive West of Copley Square Ramps	60,500	60,700	58,900
WL2	Massachusetts Turnpike (I-90) West of I-93 Ramps	40,000	49,300	60,700

Table 3.7 (Cont.)

EXISTING AND PROJECTED
AVERAGE WEEKDAY TRAFFIC VOLUMES

Highway Links		1987/88 Existing	2010 Future Baseline	2010 Proposed Action
I-90 Between:				
WL3	West Service Road On- and I-93 Off-Ramps	N/A	N/A	55,700
WL4	Massport Haul Road and West Service Road On-Ramps	N/A	N/A	49,700
WL5	Congress Street Off- and C Street/Massport Haul Road On-Ramps	N/A	N/A	33,700
WL6	I-90 C/D and Congress Street Off-Ramps	N/A	N/A	43,400
WL7	Third Harbor Tunnel (Logan Airport On- and I-90 C/D Off-Ramps)	N/A	N/A	47,600
WL8	Route 1A SB Diverge and Toll Plaza	N/A	N/A	22,400
I-90 C/D Between:				
WL9	I-90 Mainline Diverge and South Boston Bypass Road Off-Ramp	N/A	N/A	4,200
WL10	South Boston Bypass Road Off- and Congress Street On-Ramps	N/A	N/A	2,400
WL11	Congress Street On- and South Station Off-Ramps	N/A	N/A	10,400
Northbound Ramps				
NR1	Columbia Road On, to SE Expressway	14,000	15,900	20,900
NR2	Southampton Street Off, from SE Expressway	3,000	9,300	12,900
NR3	Massachusetts Avenue Off, from SE Expressway	13,000	13,600	4,400
NR4	Massachusetts Avenue On, to SE Expressway	9,000	14,800	18,500
NR5	I-90 WB/Kneeland Street Off, from SE Expressway	28,000	30,700	38,300
NR6	I-90 EB Off, from SE Expressway	N/A	N/A	20,600
NR7	I-90 WB On, to Central Artery	N/A	N/A	5,000
NR8	I-90 EB/Broadway On, to Central Artery	N/A	N/A	26,800
NR9	I-90/Broadway On, to Central Artery	19,000	16,200	N/A
NR10	South Street On, to Central Artery	19,000	25,200	N/A
NR11	Northern Avenue Off, from Central Artery	22,000	33,200	N/A
NR12	North Street Off, from Central Artery	N/A	N/A	28,000
NR13	Northern Avenue On, to Central Artery	10,500	13,600	N/A
NR14	Essex Street/Northern Avenue On, to Central Artery	N/A	N/A	34,400
NR15	Callahan Tunnel Off, from Central Artery	25,500	36,300	N/A
NR16	Sumner Tunnel On, to Central Artery	25,500	29,600	13,900

Table 3.7 (Cont.)

EXISTING AND PROJECTED AVERAGE WEEKDAY TRAFFIC VOLUMES

Highway Links		1987/88 Existing	2010 Future Baseline	2010 Proposed Action
NR17	Route 1 (Storrow Drive/Tobin Bridge)/City Square Off, from Central Artery	N/A	N/A	58,800
NR18	Storrow Drive (Leverett Circle) Off, from Central Artery	28,000	26,200	N/A
NR19	Storrow Drive (Leverett Circle) On, to Central Artery	32,000	37,700	16,900
NR20	Storrow Drive On, To Route 1 NB (Tobin Bridge)	N/A	N/A	18,900
NR21	Traverse Street/Route 1 SB/City Square On, to Central Artery	N/A	N/A	20,400
NR22	Tobin Bridge Off, from I-93	40,000	50,700	N/A
NR23	I-90 THT Off, to Route 1A	N/A	N/A	26,600
NR24	Airport Off, from Route 1A	27,200	25,200	19,200
NR25	Airport On, to Route 1A	12,000	15,400	10,600
NR26	Neptune Off, from Route 1A	10,000	16,200	21,600
Southbound Ramps				
SR1	Columbia Road On, to SE Expressway	8,500	10,100	14,800
SR2	Southampton Street/Massachusetts Avenue On, to SE Expressway	N/A	N/A	21,900
SR3	Southampton Street On, to SE Expressway	5,000	18,400	N/A
SR4	Massachusetts Avenue Off, from SE Expressway	12,500	18,700	23,200
SR5	I-90 WB On, to SE Expressway	N/A	N/A	29,900
SR6	Albany Street On, to SE Expressway	18,500	31,400	N/A
SR7	Essex Street On, to Central Artery	N/A	N/A	5,300
SR8	I-90 WB/Broadway Off	23,000	27,200	N/A
SR9	I-90 WB/Broadway On	N/A	N/A	29,900
SR10	I-90 EB/Kneeland On	23,000	20,800	18,200
SR11	I-90 WB/Broadway/CD/Off, from Central Artery	N/A	N/A	37,900
SR12	Congress Street On, to Central Artery	10,000	17,000	24,700
SR13	Dewey Square Off, from Central Artery	8,000	14,400	17,300
SR14	Oliver Street Off, from Central Artery	N/A	N/A	15,900
SR15	High Street Off, from Central Artery	12,000	17,300	N/A
SR16	New Chardon Street On, to Central Artery	N/A	N/A	23,800
SR17	Haymarket On, to Central Artery	24,000	25,200	N/A
SR18	Callahan Tunnel/Clinton Street Off, from Central Artery	N/A	N/A	32,100
SR19	Haymarket Off, from Central Artery	5,000	7,200	N/A

Table 3.7 (Cont.)

EXISTING AND PROJECTED
AVERAGE WEEKDAY TRAFFIC VOLUMES

Highway Links		1987/88 Existing	2010 Future Baseline	2010 Proposed Action
SR20	Storrow Drive Off, from Central Artery	27,000	31,500	N/A
SR21	Tobin Bridge On, to I-93	36,500	54,500	N/A
SR22	Tobin Bridge Off, from I-93	12,000	14,400	N/A
SR23	Route 1 (Storrow Drive/Tobin Bridge)/City Square Off, from I-93	N/A	N/A	31,600
SR24	Route 1 Southbound On, to Storrow Drive	N/A	N/A	21,000
SR25	Route 1 Southbound On, to I-93	N/A	N/A	40,600
SR26	Logan Airport Off, from Route 1A	12,000	18,800	12,100
SR27	Logan Airport On, to Route 1A	18,000	27,000	17,900
SR28	Route 1A On, to I-90 Third Harbor Tunnel	N/A	N/A	22,400
SR29	Neptune Road On, to Route 1A	7,500	14,900	17,000
Eastbound Ramps				
ER1	I-93/Frontage Road Off, from I-90	N/A	N/A	34,700
ER2	Congress Street Off, from I-90	N/A	N/A	21,200
ER3	Congress Street/West Service Road On, to I-90	N/A	N/A	17,400
ER4	Albany Street On, to I-90 C/D	N/A	N/A	17,600
ER5	Massport Haul Road Off, from I-90 C/D	N/A	N/A	15,500
ER6	South Boston Bypass Road On, to I-90 C/D	N/A	N/A	2,200
ER7	Logan Airport Off, from I-90	N/A	N/A	22,700
Westbound Ramps				
WR1	I-93 NB/Frontage Road NB On, to I-90	N/A	N/A	18,000
WR2	I-93 Off, from I-90	N/A	N/A	31,000
WR3	West Service Road On, to I-90	N/A	N/A	6,000
WR4	Massport Haul Road On, to I-90	N/A	N/A	16,000
WR5	Congress Street Off, from I-90	N/A	N/A	9,700
WR6	South Station Off, from I-90 C/D	N/A	N/A	300
WR7	West Service Road On, to I-90 C/D	N/A	N/A	6,000
WR8	South Boston Bypass Road Off, from I-90 C/D	N/A	N/A	1,800
WR9	Logan Airport On, to I-90	N/A	N/A	25,200

Table 3.7 (Cont.)

EXISTING AND PROJECTED
AVERAGE WEEKDAY TRAFFIC VOLUMES

Highway Links		1987/88 Existing	2010 Future Baseline	2010 Proposed Action
HOV Lanes				
I-93[2]:				
HOV1	Braintree to South Boston Bypass Road (NB)	N/A	N/A	5,500
HOV2	South Boston Bypass Road to Mainline Crossover (NB)	N/A	N/A	2,800
HOV3	Mainline Crossover to Massachusetts Avenue (NB)	N/A	N/A	2,300
HOV4	Massachusetts Avenue to South Station (NB)	N/A	N/A	5,500
HOV5	South Boston Bypass Road to Braintree (SB)	N/A	N/A	5,800
HOV6	South Station to Massachusetts Avenue (SB)	N/A	N/A	6,000
HOV7	Massachusetts Avenue to Mainline Crossover (SB)	N/A	N/A	2,200
HOV8	Mainline Crossover to South Boston Bypass Road (SB)	N/A	N/A	3,700
South Boston Bypass Road:				
SBB1	North of A Street Connector (NB)	N/A	N/A	4,700
SBB2	South of A Street Connector (NB)	N/A	N/A	5,200
SBB3	North of A Street Connector (SB)	N/A	N/A	5,200
SBB4	South of A Street Connector (SB)	N/A	N/A	5,400
HOV Daily Person Trips[2]				
HOV4	I-93 NB	N/A	N/A	50,300
HOV8	I-93 SB	N/A	N/A	54,800
EL7	I-90 EB, West of Bypass Road	N/A	N/A	33,100
WL11	I-90 WB, West of Bypass Road	N/A	N/A	26,400
EL8	I-90 EB, East of Bypass Road	N/A	N/A	34,300
WL9	I-90 WB, East of Bypass Road	N/A	N/A	34,100
SBB2	South Boston Bypass Road, SW of Dorchester Avenue, NB	N/A	N/A	14,500
SBB4	South Boston Bypass Road, SW of Dorchester Avenue, SB	N/A	N/A	9,500

1. Figures in left-hand column reference locations shown in Figures 3.3 and 3.10 to 3.15.
2. Connection is assumed to HOV contraflow lane between Massachusetts Avenue Interchange and Braintree; in the absence of the Massachusetts Avenue-Braintree lane, it is estimated that HOV use on I-93 would be approximately 57 percent of volumes shown.
3. N/A: Not applicable

Source: Bechtel/Parsons Brinckerhoff

Airport. The Tobin Bridge, a section of Route 1A near the airport, and Storrow Drive also will experience a reduction in traffic volumes relative to the 2010 baseline condition, as a result of the Proposed Action. (AWDT for mainline highway segments in the 2010 baseline and Proposed Action is shown in Figure 3.16.)

The HOV system to be provided as part of the Proposed Action also will carry substantial traffic volumes. I-93 Proposed Action HOV lanes will carry 50,300 northbound and 54,800 southbound person trips per day, assuming that the project's HOV lanes on I-93 connect to a contraflow HOV lane between the Massachusetts Avenue Interchange and Braintree. (The contraflow lane is a separate project planned independently of the Proposed Action by the Department.) In the absence of the contraflow lane, it is estimated that HOV use on the I-93 segment of the Proposed Action would be upwards of 28,000 northbound and 30,700 southbound person-trips per day. Managed collector-distributor roads on I-90 will carry between 33,100 and 34,300 HOV person trips per day in the eastbound direction and 26,400 to 34,100 westbound. The South Boston Bypass Road will carry 9,900 to 10,600 vehicles per day, which is equivalent to 24,000 person trips. The majority of vehicles on the Bypass Road will be trucks.

As noted earlier, a major benefit of the Proposed Action is that it will cause traffic volumes to decline on local streets. Table 3.8 presents AWDT volumes for a cross section of local streets in the study area (see Figure 3.4). On virtually every street, daily traffic volumes are forecast to increase substantially between 1987 and the 2010 baseline condition; the average increase for all the street segments included in the table is 38 percent. The impact of the Proposed Action will be to reduce local AWDT by an average of nearly 9 percent, relative to the baseline case. On seven of the street segments included in the table, daily traffic volumes will be lower in the 2010 Proposed Action case than they were in 1987/88. Street segments experiencing substantial reductions in traffic will include all of the Charles River and Fort Point Channel crossings into and out of downtown Boston (Charlestown Bridge, Charles River dam, and the Fort Point Channel crossings); A Street in South Boston; the Gilmore Bridge; Meridian Street northbound (north of Princetown Street) in East Boston; and Rutherford Avenue northbound in Charlestown.

These reductions in local AWDT will occur because more traffic will be using the Central Artery to cross the Charles River on the north and Kneeland Street on the south; the Seaport Access Road and Third Harbor Tunnel also will carry large volumes of traffic that would otherwise be filtering through the local street network. In addition to reducing traffic on the crossings to and from the downtown area, improved traffic flow on the Central Artery and connecting segments of the Southeast Expressway will result in the diversion of downtown-oriented traffic from the local street network in South Boston. Currently, large numbers of commuters travelling between downtown and the South Shore suburbs use routes through South Boston, to avoid congestion on I-93. This traffic pattern would intensify under the 2010 baseline condition, but will abate as a result of the Proposed Action.

While the overall impact of the Proposed Action will be to reduce AWDT on local streets, there are several locations where daily traffic is forecast to increase, as shown in Table 3.8. These include Purchase Street north of Pearl Street in downtown Boston, which is adjacent to a new exit ramp from the Central Artery; Atlantic Avenue north of Congress Street; Commercial Street southbound (south of Charter Street); and, in East Boston, Benningon Street eastbound (west of Prescott Street).

FIGURE 3.8

2010 Future Baseline Cordon Crossings: AM And PM Peak Hours; 24 Hours

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

FIGURE 3.9

2010 Proposed Action Cordon Crossings: AM And PM Peak Hours; 24 Hours

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

FIGURE 3.10

Proposed Action Highway Links, Ramps and HOV's –
Area North Of Causeway Street

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

FIGURE 3.11

Proposed Action Highway Links, Ramps and HOV's – Central Area

COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

FEET

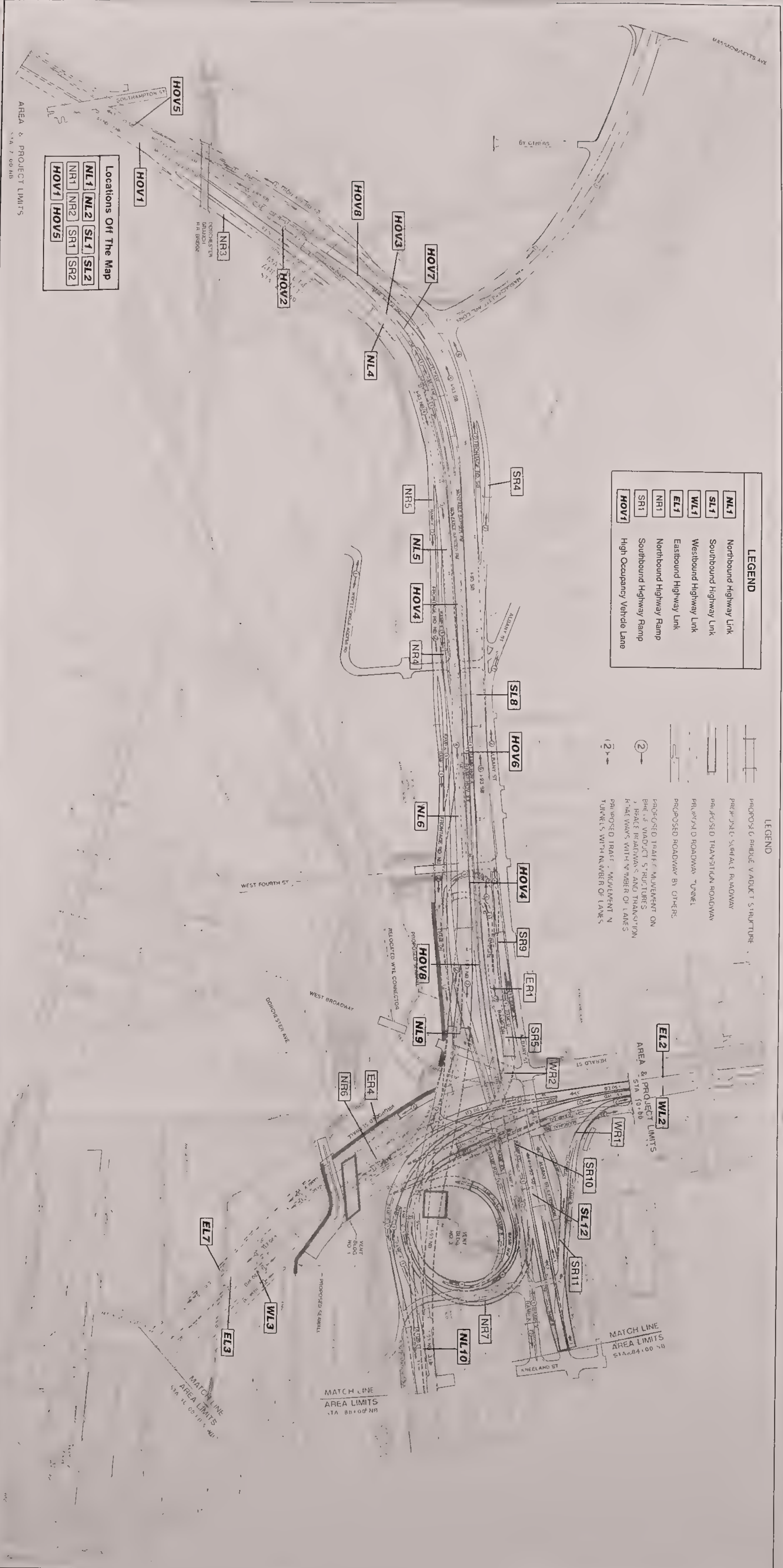


FIGURE 3.12

Proposed Action Highway Links, Ramps and HOV's –
I-93/I-90 Interchange And Mass. Ave. Interchange Area

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

FIGURE 3.13 **Proposed Action Highway Links, Ramps and HOV's –**
So. Boston/So. Boston Bypass Road Area

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

0 100 200 400 800
FEET

FIGURE 3.14 **Proposed Action Highway Links, Ramps and HOV's –**
So. Boston/So. Boston Bypass Road Area

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

FIGURE 3.15

Proposed Action Highway Links, Ramps and HOV's –
East Boston/Logan Airport Area

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

0 100 200 400 800
FEET

FIGURE 3.16

Average Weekday Traffic Volumes On Major Highway Links

The Commonwealth of Massachusetts Department of Public Works
Central Artery (I-93)/Third Harbor Tunnel (I-90) Project
SUPPLEMENTAL EIS

0 800 1600 2400 3200 Feet

Table 3.8

EXISTING AND PROJECTED AVERAGE WEEKDAY DAILY TRAFFIC ON SELECTED SURFACE STREET LINKS

Highway Links		1987/88 Existing	2010 Future Baseline	2010 Proposed Action
ML1	Old Colony Avenue N of Columbia NB	14,500	18,400	16,800
ML3	Massachusetts Avenue S of Glynn NB	8,300	8,500	10,300
ML5	Columbus Avenue N of Mass NB	6,100	9,600	9,200
ML7	Huntington Avenue N of Mass NB	10,700	11,600	11,800
ML9	Boylston Street E of Mass EB	12,500	16,500	16,200
ML11	Broadway Bridge EB	15,600	17,700	12,900
ML13	A Street N of West Second NB	6,700	10,000	7,400
ML15	D Street N of Cypher NB	4,400	5,200	4,300
ML18	Summer Street Bridge EB	16,600	18,800	12,900
ML20	Congress Street Bridge EB	8,500	10,400	5,100
ML24	Atlantic N of Congress NB	19,100	20,700	30,200
ML25	Congress Street N of State NB	17,000	21,500	22,600
ML27	Cambridge Street N of Court NB	9,000	10,500	10,700
ML28	Commercial Street S of Charter NB	11,100	11,100	10,200
ML30	Charlestown Bridge NB	28,100	31,700	22,300
ML32	Charles River Dam EB	26,000	29,700	26,700
ML34	Harvard Bridge EB	10,000	19,000	17,600
ML36	Gilmore Bridge NB	13,800	22,600	13,900
ML38	Rutherford Avenue N of Austin NB	19,500	28,700	25,100
ML40	Meridian Street N of Princeton NB	6,700	8,300	6,900
ML41	Bennington Street W of Prescott EB	5,000	4,800	5,700
ML42	Chelsea Street N of Porter NB	5,000	5,500	4,700
ML2	Old Colony Avenue N of Columbia SB	15,700	21,300	16,100
ML4	Berkeley Street E of Tremont WB	11,100	16,900	15,500
ML6	Columbus Avenue N of Mass SB	7,700	10,200	8,700
ML8	Huntington Avenue N of Mass SB	11,100	19,500	20,500
ML10	Boylston Street E of Mass WB	1,500	1,700	2,000
ML12	Broadway Bridge WB	16,200	17,400	11,700
ML14	A Street N of West Second SB	5,600	10,900	7,200
ML16	D Street N of Cypher SB	4,500	4,900	5,900
ML17	Boston Street S of Andrew Square SB	5,000	6,300	2,800
ML19	Summer Street Bridge WB	12,500	18,500	15,200
ML21	Congress Street Bridge WB	4,200	9,200	7,500
ML22	Harrison Avenue N of Kneeland SB	6,200	13,300	11,300
ML23	Purchase Street N of Pearl SB	18,500	19,900	33,400
ML26	Congress Street N of State SB	14,000	23,900	19,900

Table 3.8 (Cont.)

EXISTING AND PROJECTED AVERAGE WEEKDAY DAILY TRAFFIC ON SELECTED SURFACE STREET LINKS

Highway Links		1987/88 Existing	2010 Future Baseline	2010 Proposed Action
ML29	Commercial Street S of Charter SB	9,700	14,500	15,700
ML31	Charlestown Bridge SB	25,000	32,600	21,800
ML33	Charles River Dam WB	18,000	26,000	20,100
ML35	Harvard Bridge WB	10,000	21,900	22,200
ML37	Gilmore Bridge SB	13,500	21,300	17,100
ML39	Rutherford Avenue N of Austin SB	29,700	35,100	29,700

1. Numbers in left-most column reference locations shown in Figure 3.4

Source: Bechtel/Parsons Brinckerhoff

Traffic on local streets also was analyzed for the SEIS/R in terms of screenline crossings. (A screenline is an imaginary line drawn across adjacent roadways.) Analysis of screenlines, in contrast to individual roadway segments, accounts for redistribution of traffic among parallel streets, and therefore provides a more comprehensive measure of travel pattern changes. The 13 screenlines analyzed are distributed throughout the core of the study area, including downtown Boston, South Boston, and East Boston, and were selected to intercept major traffic flows on city streets (see Table 3.9 and Figure 3.17).

Under the Proposed Action, traffic volumes on local streets will decline relative to the 2010 baseline at all but one of the screenlines, the exception being the Cambridge-Tremont Streets screenline, where local traffic will increase by 2 percent. At the remaining downtown screenlines, including the screenlines across the Charles River and Fort Point Channel, local traffic volumes will decrease on average by over 9 percent as a result of the Proposed Action. Traffic across only the screenlines representing gateways to and from the downtown area will decline by an even greater margin; the percentage decreases under the Proposed Action will be 22 percent at Kneeland Street, 25 percent across the Fort Point Channel, and 14 percent across the Charles River screenline.

Three screenlines were analyzed in East Boston. On average, traffic crossing these screenlines will decline by almost 14 percent as a result of the Proposed Action. At the screenline analyzed in South Boston, which crosses the western half of South Boston between Fort Point Channel and Summer Street, the Proposed Action will cause traffic volumes to decrease by 17 percent.

3.2.3(c) Peak Hour Traffic Volumes

AM and PM peak hour traffic volumes are measured against capacity in the analysis of traffic operating conditions. While daily traffic volume is a somewhat abstract concept, peak hour volumes are what motorists experience directly; these data, therefore, serve as a basis for facility design. Table 3.10 compares peak hour traffic volumes for selected roadway segments and intersections throughout the study area for existing conditions, the 2010 baseline and the Proposed Action (see Figures 3.3, 3.4 and 3.10 to 3.15).

Capacity constraints on the Central Artery during the AM and PM peak hours in the 2010 baseline condition would govern traffic volumes with the result that increases at critical locations on I-93 would be negligible and motorists would divert to the surface street network. The Proposed Action, however, will allow for substantial increases in peak hour traffic volumes on I-93, which will result in reduced volumes and improved operations on local roadways.

In the future baseline case, AM peak hour volumes on the Central Artery would range from 3,620 vehicles per hour (VPH) in the northbound direction between the Storrow Drive off- and on-ramps, to 6,890 VPH northbound between the South Street on-ramp and Northern Avenue off-ramp. In the PM peak hour, traffic volumes along the Central Artery would continue to be slightly lower than in the AM peak hour, as they are today, due to severe congestion, with respective loads of 3,400 and 4,850 VPH at the same aforementioned locations along the highway. Sumner Tunnel PM peak volumes (2,950 VPH) in the 2010 baseline condition also would continue to be constrained by congestion at the Central Artery portal, and would, therefore, be lower than AM peak hour volumes (3,800 VPH). Callahan Tunnel traffic would be less constrained, as evidenced by a more consistent volume range of between 3,410 and 3,940 VPH during the AM and PM peak hours.

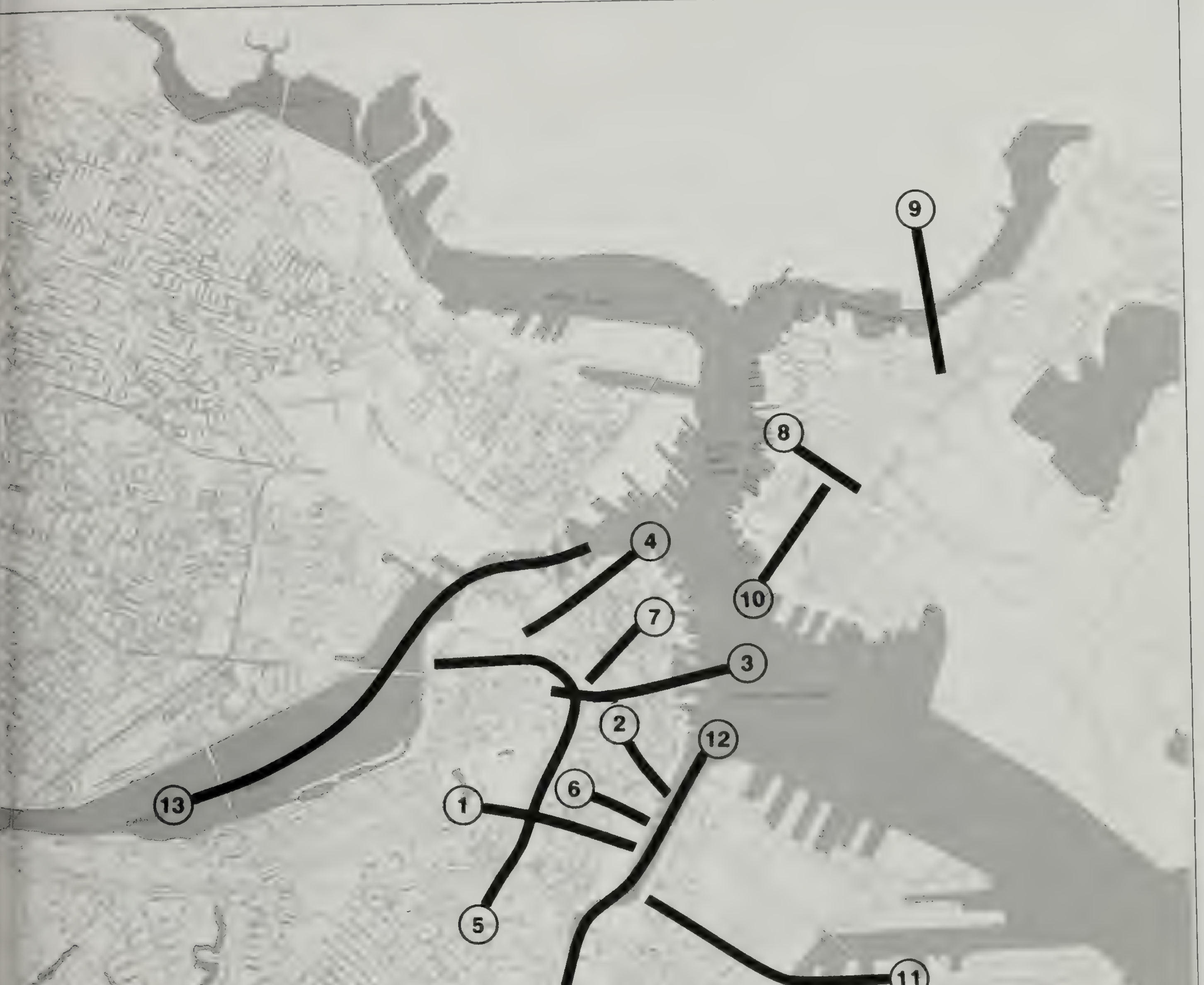
Table 3.9

PROJECTED AVERAGE WEEKDAY DAILY TRAFFIC SCREENLINE CROSSINGS

	Screenlines	2010 Baseline	2010 Proposed Action	Percent Change
1.	Kneeland Street	162,962	127,102	-22
2.	Oliver-Pearl Streets	67,926	65,832	-3
3.	State Street	125,511	122,116	-3
4.	Causeway Street	158,460	156,590	-1
5.	Cambridge-Tremont Streets	267,372	272,843	2
6.	South Station/Summer Street	72,527	54,595	-25
7.	Hanover Street	76,044	74,754	-2
8.	East Boston-Visconti Way/Porter Street	37,257	33,670	-10
9.	East Boston Day Square	53,989	52,712	-2
10.	East Boston Bremen Street	28,780	17,338	-40
11.	South Boston Cypher-West First Streets	85,802	70,844	-17
12.	Fort Point Channel	146,862	109,777	-25
13.	Charles River	191,619	165,201	-14
	Combined Volume of all Screenlines	1,475,111	1,323,374	-10

1. Detailed screenline data provided in Transportation Appendix

Source: Bechtel/Parsons Brinckerhoff



FIGURE

3.17

Screenline Crossings

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

Table 3.10

EXISTING AND PROJECTED AM AND PM PEAK HOUR TRAFFIC VOLUMES

Highway Links	1987 Existing		2010 Future Baseline		2010 Proposed Action	
	AM	PM	AM	PM	AM	PM
Northbound Links						
Southeast Expressway Between:						
NL1 Columbia Road Off- and On-Ramps	6,700	3,700	6,320	4,430	7,000	5,040
NL2 Columbia Road On- and Southampton Street Off-Ramps	7,600	4,400	7,890	5,450	7,860	5,820
NL3 Massachusetts Avenue and East Berkeley Street On-Ramps	4,660	2,500	5,390	3,500	N/A	N/A
NL4 Massachusetts Avenue and I-90 WB/ Broadway Off-Ramps	N/A	N/A	N/A	N/A	7,100	5,080
NL5 I-90 WB/Broadway Off- and Massachusetts Avenue On-Ramps	N/A	N/A	N/A	N/A	4,710	3,530
NL6 Massachusetts Avenue On- and Third Harbor Tunnel (I-90 EB) Off-Ramps	N/A	N/A	N/A	N/A	6,020	5,300
NL7 East Berkeley Street On- and I-90/ Kneeland Street Off-Ramps	5,630	3,450	6,260	4,510	N/A	N/A
NL8 I-90 Kneeland Street Off- and I-90/ Broadway On-Ramps	4,060	1,850	4,590	2,310	N/A	N/A
NL9 I-90 EB Off- and I-90 WB On-Ramps	N/A	N/A	N/A	N/A	4,390	4,310
NL10 I-90 WB and I-90 EB/Broadway On-Ramps	N/A	N/A	N/A	N/A	4,710	5,150
Central Artery Between:						
NL11 South Street On- and Northern Avenue Off-Ramps	6,430	4,050	6,890	4,850	N/A	N/A
NL12 Sumner Tunnel On- and Causeway Street Off-Ramps	N/A	N/A	N/A	N/A	6,780	7,120
NL13 Northern Avenue On- and Callahan Tunnel Off-Ramps	6,100	4,300	6,750	4,830	N/A	N/A
NL14 Callahan Tunnel Off- and Sumner Tunnel On-Ramps	4,425	3,050	4,870	3,420	N/A	N/A
NL18 Sumner Tunnel On- and Route 1 Off-Ramps	N/A	N/A	N/A	N/A	7,550	8,470
NL19 Storrow Drive Off- and On-Ramps	2,900	3,150	3,620	3,400	N/A	N/A
NL20 Storrow Drive On- and Route 1 (Tobin Bridge) Off-Ramps	4,600	5,600	5,780	6,200	N/A	N/A

Table 3.10 (Cont.)

EXISTING AND PROJECTED AM AND PM PEAK HOUR TRAFFIC VOLUMES

Highway Links		1987 Existing AM	1987 Existing PM	2010 Future Baseline AM	2010 Future Baseline PM	2010 Proposed Action AM	2010 Proposed Action PM
NL21	Valenti Way/City Square and Leverett Circle On-Ramps	N/A	N/A	N/A	N/A	3,910	5,380
NL22	I-93 between Route 1 Ramps	2,550	3,350	2,600	3,100	3,140	3,880
NL23	I-93 North of Route 1 Interchange	2,600	4,200	3,260	4,460	5,020	6,650
NL24	Route 1 North of I-93 Ramps	2,950	3,150	3,800	4,430	3,400	4,610
Route 1A Between:							
NL25	Toll Plaza and Logan Airport Off-Ramp	2,550	3,100	3,180	3,490	3,170	3,100
NL26	Logan Airport On-and Neptune Road Off-Ramps	1,750	3,770	3,650	4,380	N/A	N/A
NL27	I-90 EB (Third Harbor Tunnel) On- and Neptune Road Off-Ramps	N/A	N/A	N/A	N/A	2,520	3,910
NL28	Route 1A North of Neptune Road Off-Ramp	950	4,820	1,800	2,340	1,790	2,590
NL29	Callahan Tunnel	2,700	3,500	3,410	3,940	2,380	3,420
Southbound Links							
Southeast Expressway Between:							
SL1	Southampton Street On- and Columbia Road Off-Ramps	4,700	7,300	5,050	7,840	5,910	7,960
SL2	Boston Street Off- and Southampton Street/Massachusetts Avenue On-Ramps	N/A	N/A	N/A	N/A	4,480	6,170
SL3	Boston Street Off- and Southampton Street On-Ramps	4,530	6,880	4,870	7,170	N/A	N/A
SL4	Massachusetts Avenue On- and Boston Street Off-Ramps	5,120	7,380	5,430	7,850	N/A	N/A
SL5	Massachusetts Avenue and Boston Street Off-Ramps	N/A	N/A	N/A	N/A	N/A	N/A
SL6	Massachusetts Avenue Off- and On-Ramps	4,570	6,150	4,690	6,710	N/A	N/A

Table 3.10 (Cont.)

EXISTING AND PROJECTED AM AND PM PEAK HOUR TRAFFIC VOLUMES

		1987 Existing		2010 Future Baseline		2010 Proposed Action	
Highway Links		**AM**	**PM**	**AM**	**PM**	**AM**	**PM**
SL7	East Berkeley/Albany Streets On- and Massachusetts Avenue Off-Ramps	5,300	6,800	5,690	7,780	N/A	N/A
SL8	I-90 WB On- and Massachusetts Avenue Off-Ramps	N/A	N/A	N/A	N/A	7,440	8,610
SL9	East Barrel between Essex Street On-Ramp and Central Artery West Barrel	N/A	N/A	N/A	N/A	3,120	3,860
SL10	West Barrel between Congress Street On- and I-90 WB/Albany Street Off-Ramps	N/A	N/A	N/A	N/A	4,180	4,480
Central Artery Between:							
SL11	I-90/Kneeland Street On-and East Berkeley Street Off-Ramps	5,270	5,350	5,870	5,810	N/A	N/A
SL12	I-90 EB/Kneeland Street and I-90 WB On-Ramps	N/A	N/A	N/A	N/A	6,000	6,730
SL13	Beach Street and I-90/Broadway Off-Ramps	4,900	5,100	5,680	5,690	N/A	N/A
SL14	Congress Street On- and Beach Street Off-Ramps	5,400	5,400	5,890	6,080	N/A	N/A
SL15	Purchase Street On- and Dewey Square (Summer Street) Off-Ramps	5,500	4,400	6,440	4,900	N/A	N/A
SL16	Oliver Street and Dewey Square (Summer Street) Off-Ramps	N/A	N/A	N/A	N/A	7,340	6,740
SL17	Haymarket On- and High Street Off-Ramps	6,100	3,900	6,620	4,330	N/A	N/A
SL18	New Chardon Street On- and Oliver Street Off-Ramps	N/A	N/A	N/A	N/A	8,890	7,460
SL19	Callahan Tunnel Off- and Haymarket On-Ramps	4,700	3,150	5,020	3,550	N/A	N/A
SL20	Causeway Street On- and Callahan Tunnel Off-Ramps	6,000	3,900	6,280	4,630	N/A	N/A
SL21	Leverett Circle On- and Callahan Tunnel/Clinton Street Off-Ramps	N/A	N/A	N/A	N/A	9,920	8,270

Table 3.10 (Cont.)

EXISTING AND PROJECTED AM AND PM PEAK HOUR TRAFFIC VOLUMES

		1987 Existing		2010 Future Baseline		2010 Proposed Action	
Highway Links		**AM**	**PM**	**AM**	**PM**	**AM**	**PM**
SL22	Leverett Circle On- and Haymarket Off-Ramps	4,800	3,250	4,740	3,780	N/A	N/A
SL23	Route 1 SB (Tobin Bridge) On- and Leverett Circle Off-Ramps	4,900	4,550	5,500	5,510	N/A	N/A
SL24	Route 1 SB (Tobin Bridge) and Leverett Circle On-Ramps	N/A	N/A	N/A	N/A	8,210	6,470
SL25	I-93 Between Route 1 Ramps	N/A	N/A	N/A	N/A	4,630	3,330
SL26	I-93 North of Tobin Bridge Ramps	4,000	3,550	4,640	3,790	6,800	5,060
SL27	Route 1 North of I-93 Ramps	1,850	2,750	3,380	3,260	4,110	3,420
Route 1A Between:							
SL28	Logan Airport On-Ramp and Toll Plaza	2,880	1,75-	3,350	2,370	1,960	2,680
SL29	Logan Airport Off- and On-Ramps	2,000	2,530	3,350	2,370	1,120	1,150
SL30	I-90 WB (Third Harbor Tunnel) and Logan Airport Off-Ramps	N/A	N/A	N/A	N/A	2,060	1,870
SL31	Neptune Road On- and I-90 WB (Third Harbor Tunnel) Off-Ramps	N/A	N/A	N/A	N/A	4,240	3,390
SL32	Neptune Road On- and Logan Airport Off-Ramps	2,830	2,530	4,240	3,780	N/A	N/A
SL33	Route 1A North of Neptune Road Off-Ramp	2,030	1,060	2,160	1,620	2,520	3,910
SL34	Sumner Tunnel (Route 1A)	3,400	2,200	3,800	2,590	3,030	2,650
Eastbound Links							
EL1	Storrow Drive West of Copley Square Ramps	3,700	3,000	3,860	3,660	4,420	3,820
EL2	Massachusetts Turnpike (I-90) West of I-93 Ramps	5,000	2,600	5,230	3,140	5,950	3,940

Table 3.10 (Cont.)

EXISTING AND PROJECTED AM AND PM PEAK HOUR TRAFFIC VOLUMES

Highway Links	1987 Existing AM	1987 Existing PM	2010 Future Baseline AM	2010 Future Baseline PM	2010 Proposed Action AM	2010 Proposed Action PM
I-90 Between:						
EL3 I-93 On- and Congress Street Off-Ramps	N/A	N/A	N/A	N/A	3,920	2,540
EL4 Congress Street and I-90 C/D On-Ramps	N/A	N/A	N/A	N/A	2,550	2,740
EL5 Third Harbor Tunnel (I-90 C/D On- to Logan Airport Off-Ramps)	N/A	N/A	N/A	N/A	3,300	3,360
EL6 Logan Airport Off-Ramp to Route 1A	N/A	N/A	N/A	N/A	1,570	2,070
I-90 C/D Between:						
EL7 Albany Street On- and Massport Haul Road Off-Ramps	N/A	N/A	N/A	N/A	1,570	1,750
EL8 Massport Haul Road Off-Ramp and Merge to I-90 Mainline	N/A	N/A	N/A	N/A	760	2,740
Westbound Links						
WL1 Storrow Drive West of Copley Square Ramps	4,690	3,750	4,950	3,580	5,660	3,640
WL2 Massachusetts Turnpike (I-90) West of I-93 Ramps	2,200	3,800	2,510	4,060	3,990	5,140
I-90 Between:						
WL3 West Service Road On- and I-93 Off-Ramps	N/A	N/A	N/A	N/A	3,170	4,570
WL4 Massport Haul Road and West Service Road On-Ramps	N/A	N/A	N/A	N/A	3,309	3,850
WL5 Congress Street Off- and C Street/ Massport Haul Road On-Ramps	N/A	N/A	N/A	N/A	2,217	2,240
WL6 I-90 C/D and Congress Street Off-Ramps	N/A	N/A	N/A	N/A	3,080	2,940
WL7 Third Harbor Tunnel (Logan Airport On- and I-90 C/D Off-Ramps)	N/A	N/A	N/A	N/A	3,400	3,330
WL8 Route 1A SB Diverge and Toll Plaza	N/A	N/A	N/A	N/A	2,180	1,520
I-90 C/D Between:						
WL9 I-90 Mainline Diverge and South Boston Bypass Road Off-Ramp	N/A	N/A	N/A	N/A	320	400
WL10 South Boston Bypass Road Off-and Congress Street On-Ramps	N/A	N/A	N/A	N/A	340	320

Table 3.10 (Cont.)

EXISTING AND PROJECTED AM AND PM PEAK HOUR TRAFFIC VOLUMES

	1987 Existing		2010 Future Baseline		2010 Proposed Action	
Highway Links	AM	PM	AM	PM	AM	PM
WL11 Congress Street On- and South Station Off-Ramps	N/A	N/A	N/A	N/A	730	850
Northbound Ramps						
NR1 Columbia Road On, to SE Expressway	790	690	1,570	1,010	860	780
NR2 Southampton Street Off, from SE Expressway	470	100	300	210	500	450
NR3 Massachusetts Avenue Off, from SE Expressway	600	220	970	970	270	300
NR4 Massachusetts Avenue On, to SE Expressway	520	1,200	870	460	1,310	1,770
NR5 I-90 WB/Kneeland Street Off, from SE Expressway	1,570	1,600	1,680	2,200	2,650	1,550
NR6 I-90 EB Off, from SE Expressway	N/A	N/A	N/A	N/A	1,630	990
NR7 I-90 WB On, to Central Artery	N/A	N/A	N/A	N/A	320	850
NR8 I-90 EB/Broadway On, to Central Artery	N/A	N/A	N/A	N/A	2,070	1,970
NR9 I-90/Broadway On, to Central Artery	1,500	400	1,470	370	N/A	N/A
NR10 South Street On, to Central Artery	870	1,800	840	2,180	N/A	N/A
NR11 Northern Avenue Off, from Central Artery	1,950	1,750	2,290	2,500	N/A	N/A
NR12 North Street Off, from Central Artery	N/A	N/A	N/A	N/A	1,970	1,710
NR13 Northern Avenue On, to Central Artery	520	1,200	630	850	N/A	N/A
NR14 Essex Street/Northern Avenue On, to Central Artery	N/A	N/A	N/A	N/A	1,650	2,060
NR15 Callahan Tunnel Off, from Central Artery	1,670	1,250	1,890	1,420	N/A	N/A
NR16 Sumner Tunnel On, to Central Artery	1,580	1,150	1,590	1,130	1,080	1,000
NR17 Route 1 (Storrow Drive/Tobin Bridge)/ City Square Off, from Central Artery	N/A	N/A	N/A	N/A	4,410	4,590
NR18 Storrow Drive (Leverett Circle) Off, from Central Artery	2,200	700	2,130	550	N/A	N/A
NR19 Storrow Drive (Leverett Circle) On, to Central Artery	1,700	2,450	2,160	2,780	1,110	1,260
NR20 Storrow Drive On, To Route 1 NB (Tobin Bridge)	N/A	N/A	N/A	N/A	1,570	2,070

Table 3.10 (Cont.)

EXISTING AND PROJECTED AM AND PM PEAK HOUR TRAFFIC VOLUMES

	1987 Existing		2010 Future Baseline		2010 Proposed Action	
Highway Links	**AM**	**PM**	**AM**	**PM**	**AM**	**PM**
NR21 Route 1 SB/City Square On, to Central Artery	50	850	670	1,350	770	1,500
NR22 Tobin Bridge Off, from I-93	2,380	2,080	3,190	3,100	N/A	N/A
NR23 I-90 THT Off, to Route 1A	1,000	2,420	2,810	3,020	400	660
NR24 Airport Off, from Route 1A	1,800	1,750	2,930	2,130	1,730	1,290
Southbound Ramps						
SR1 Columbia Road On, to SE Expressway	320	870	1,510	1,710	690	680
SR2 Southampton/Massachusetts Avenue On, to SE Expressway	N/A	N/A	N/A	N/A	1,440	,1880
SR3 Southampton Street On, to SE Expressway	170	420	190	670	N/A	N/A
SR4 Massachusetts Avenue Off, from SE Expressway	730	650	1,000	1,070	1,990	1,390
SR5 I-90 WB On, to SE Expressway	N/A	N/A	N/A	N/A	1,440	1,880
SR6 Albany Street On, to SE Expressway	600	1,700	540	2,030	N/A	N/A
SR7 Essex Street On, to Central Artery	N/A	N/A	N/A	N/A	110	660
SR8 I-90 WB/Broadway Off	1,030	1,200	1,390	1,440	N/A	N/A
SR9 I-90 WB/Broadway On	N/A	N/A	N/A	N/A	2,740	3,000
SR10 I-90 EB/Kneeland On	N/A	N/A	N/A	N/A	1,440	1,390
SR11 I-90 WB/Broadway/CD/Off, from Central Artery	N/A	N/A	N/A	N/A	2,740	3,000
SR12 Congress Street On, to Central Artery	400	1,300	300	1,300	1,120	2,020
SR13 Dewey Square Off, from Central Artery	500	300	660	120	2,260	1,080
SR14 Oliver Street Off, from Central Artery	N/A	N/A	N/A	N/A	1,550	720
SR15 High Street Off, from Central Artery	1,300	450	1,340	830	N/A	N/A
SR16 New Chardon Street On, to Central Artery	N/A	N/A	N/A	N/A	1,480	1,520
SR17 Haymarket On, to Central Artery	1,400	750	1,600	800	N/A	N/A
SR18 Callahan Tunnel/Clinton Street Off, from Central Artery	1,300	750	1,260	1,080	2,520	2,330
SR19 Haymarket Off, from Central Artery	450	350	260	250	N/A	N/A
SR20 Storrow Drive Off, from Central Artery	1,850	1,980	2,160	2,420	N/A	N/A
SR21 Tobin Bridge On, to I-93	1,890	2,680	2,280	2,840	3,590	3,140

Table 3.10 (Cont.)

EXISTING AND PROJECTED AM AND PM PEAK HOUR TRAFFIC VOLUMES

Highway Links		1987 Existing		2010 Future Baseline		2010 Proposed Action	
		AM	PM	AM	PM	AM	PM
SR22	Tobin Bridge Off, from I-93	2,460	1,610	1,420	920	N/A	N/A
SR23	Route 1 (Storrow Drive/Tobin Bridge)/ City Square Off, from I-93	N/A	N/A	N/A	N/A	2,170	1,740
SR24	Route 1 Southbound, On, to Storrow Drive	N/A	N/A	N/A	N/A	1,860	1,620
SR25	Route 1 Southbound On, to I-93	N/A	N/A	N/A	N/A	3,590	3,140
SR26	Logan Airport Off, from Route 1A	N/A	N/A	N/A	N/A	3,590	3,140
SR27	Logan Airport On, to Route 1A	830	780	880	1,410	940	720
SR27	Route 1A On, to I-90 Third Harbor Tunnel	880	0	0	0	850	1,530
SR28	Route 1A On, to I-90 Third Harbor Tunnel	N/A	N/A	N/A	N/A	2,180	1,520
SR29	Neptune Road On, to Route 1A	800	1,500	2,080	2,150	1,450	1,530
Eastbound Ramps							
ER1	I-93/Frontage Road Off, from I-90	N/A	N/A	N/A	N/A	3,240	2,100
ER2	Congress Street Off, from I-90	N/A	N/A	N/A	N/A	2,240	1,350
ER3	Congress Street/West Service Road On, to I-90	N/A	N/A	N/A	N/A	870	1,540
ER4	Albany Street On, to I-90 C/D	N/A	N/A	N/A	N/A	880	1,270
ER5	Massport Haul Road Off, from I-90 C/D	N/A	N/A	N/A	N/A	480	750
ER6	South Boston Bypass Road On, to I-90 C/D	N/A	N/A	N/A	N/A	190	70
ER7	Logan Airport Off, from I-90	N/A	N/A	N/A	N/A	1,730	1,290
Westbound Ramps							
WR1	I-93 NB/Frontage Road NB On, to I-90	N/A	N/A	N/A	N/A	1,480	1,380
WR2	I-93 Off, from I-90	N/A	N/A	N/A	N/A	2,140	2,600
WR3	West Service Road On, to I-90	N/A	N/A	N/A	N/A	400	730
WR4	Massport Haul Road On to I-90	N/A	N/A	N/A	N/A	1,090	1,610
WR5	Congress Street Off, from I-90	N/A	N/A	N/A	N/A	660	700
WR6	South Station Off, from I-90 C/D	N/A	N/A	N/A	N/A	40	10
WR7	West Service Road On, to I-90 C/D	N/A	N/A	N/A	N/A	390	530

Table 3.10 (Cont.)

EXISTING AND PROJECTED AM AND PM PEAK HOUR TRAFFIC VOLUMES

Highway Links		1987 Existing		2010 Future Baseline		2010 Proposed Action	
		AM	PM	AM	PM	AM	PM
WR8	South Boston Bypass Road Off, from I-90 C/D	N/A	N/A	N/A	N/A	190	210
WR9	Logan Airport On, to I-90	N/A	N/A	N/A	N/A	1,220	1,820
HOV Lanes							
I-93:							
HOV1	Braintree to South Boston Bypass Road (NB)	N/A	N/A	N/A	N/A	1,510	0
HOV2	South Boston Bypass Road to Mainline Crossover (NB)	N/A	N/A	N/A	N/A	1,100	0
HOV3	Mainline Crossover to Massachusetts Avenue (NB)	N/A	N/A	N/A	N/A	960	0
HOV4	Massachusetts Avenue to South Station (NB)	N/A	N/A	N/A	N/A	820	300
HOV5	South Boston Bypass Road to Braintree (SB)	N/A	N/A	N/A	N/A	0	1,480
HOV6	South Station to Massachusetts Avenue (SB)	N/A	N/A	N/A	N/A	0	1,160
HOV7	Massachusetts Avenue to Mainline Crossover (SB)	N/A	N/A	N/A	N/A	0	920
HOV8	Mainline Crossover to South Boston Bypass Road (SB)	N/A	N/A	N/A	N/A	480	1,240
South Boston Bypass Road:							
SBB1	North of A Street Connector (NB)	N/A	N/A	N/A	N/A	470	310
SBB2	South of A Street Connector (NB)	N/A	N/A	N/A	N/A	620	370
SBB3	North of A Street Connector (SB)	N/A	N/A	N/A	N/A	280	530
SBB4	South of A Street Connector (SB)	N/A	N/A	N/A	N/A	250	650
Intersections - Downtown Boston							
I-1	Leverett Circle	6,500	5,800	6,470	5,550	4,580	4,240
I-2	North Washington/Chelsea Streets	2,050	3,100	6,960	7,520	6,470	6,620
I-3	Herald/Albany/Broadway Streets	2,260	2,700	3,160	3,460	4,250	3,990
I-4	Kneeland Street/Surface Artery	2,480	3,920	2,920	4,080	3,540	4,050

Table 3.10 (Cont.)

EXISTING AND PROJECTED AM AND PM PEAK HOUR TRAFFIC VOLUMES

Highway Links		1987 Existing AM	1987 Existing PM	2010 Future Baseline AM	2010 Future Baseline PM	2010 Proposed Action AM	2010 Proposed Action PM
I-5	Atlantic Avenue/Kneeland Street	2,480	2,050	3,030	2,580	2,360	1,250
I-6	Essex Street/Surface Artery/Lincoln	3,140	3,350	4,790	5,440	4,040	4,390
I-7	Atlantic Avenue/Summer Street	2,530	2,180	2,650	3,040	2,890	3,070
I-9	Atlantic Avenue/Congress Street	2,910	3,200	3,700	3,980	3,680	3,690
I-10	Purchase/Summer Streets	1,680	1,730	1,920	2,090	3,460	3,480
I-11	Purchase/Congress Streets	2,200	2,980	2,600	3,540	3,480	4,450
I-12	New Sudbury/Blackstone Streets	1,000	1,600	1,510	2,370	1,040	1,460
I-13	North Street/Blackstone Street/ Southbound Off	2,730	3,030	1,960	3,550	2,200	1,880
I-14	Clinton Street/Surface Artery	2,100	2,850	2,140	3,600	1,800	1,540
I-15	Atlantic Avenue Connector/Surface Artery SB	--	--	--	--	3,070	2,120
I-16	Congress/North Streets	1,790	2,360	3,420	3,750	3,820	3,720
I-17	Causeway/North Washington/ Commercial Streets	4,580	5,030	5,060	4,750	4,180	4,520
I-18	Causeway/Merrimac/Staniford Streets/Lomasney Street	2,660	2,340	3,620	4,170	4,570	3,940
I-19	New Chardon/Merrimac Streets	2,990	2,180	3,670	4,350	5,210	3,850
I-20	New Chardon Street/Surface Artery	2,030	1,900	2,530	2,810	3,780	3,090
I-21	Sudbury/Congress/Merrimac Streets	2,190	2,900	3,480	5,570	4,190	4,140
I-22	State Street/Surface Artery	1,970	3,440	2,040	4,050	3,600	2,430
I-23	State/Congress Streets	1,800	1,8650	1,890	2,560	2,380	2,230
I-24	Congress Street/Dorchester Avenue	1,960	1,920	2,680	2,290	1,720	
Intersections - South Boston							
I-25	Andrew Square	2,060	1,740	2,670	2,590	2,830	
I-26	Broadway/I Street	1,210	1,160	1,510	1,640	1,220	1,350
I-27	Summer/D Streets	1,760	1,760	1,930	2,170	1,700	1,500
I-28	Summer/East First Streets	1,800	1,760	1,930	2,300	1,390	2,070
I-29	Broadway/Dorchester Avenue	2,980	2,680	3,200	3,270	3,380	2,660
I-30	Old Colony/Dorchester Avenues	2,500	3,300	2,680	3,560	2,290	2,250

Table 3.10 (Cont.)

EXISTING AND PROJECTED
AM AND PM PEAK HOUR TRAFFIC VOLUMES

Highway Links		1987 Existing AM	1987 Existing PM	2010 Future Baseline AM	2010 Future Baseline PM	2010 Proposed Action AM	2010 Proposed Action PM
Intersections - East Boston							
I-31	Sumner/Bremen Streets	570	650	760	490	400	310
I-32	Chelsea Street/Visconti Way	1,030	1,160	1,240	1,210	1,130	1,050
I-33	Porter/Bremen Streets	500	760	1,110	1,160	630	1,040
I-34	Porter/London Streets	1,740	700	1,850	1,220	1,670	
I-35	Porter Street/Harborside Drive	1,160	2,140	1,480	2,540	1,260	2,490
I-36	Meridian/Saratoga Streets	1,110	1,280	1,160	1,500	1,070	700
I-37	Bennington Street/Neptune Road	2,240	2,470	2,340	2,660	3,250	3,070
I-38	Condor/Meridian Streets	1,230	1,610	1,740	2,260	1,340	1,640

1. Purchase/Congress Street volumes will change when Oliver Street at the Purchase Street off-ramp is changed to one-way westbound (no-build), (through volume on Purchase should decrease from current no-build)
2. N/A: Not applicable

Source: Bechtel/Parsons Brinckerhoff

In the Proposed Action case, traffic volumes on the expressway system will be drawn off of local streets and onto the new Central Artery as a result of expanded roadway capacity. During the AM peak hour, volumes on the Central Artery will range from a low of 6,470 VPH northbound north of the Essex/Northern Avenue on-ramp (including volumes on the ramp), to a high volume of 9,920 VPH southbound between the Leverett Circle on- and Callahan Tunnel/Clinton Street off-ramps. During the PM peak hour, traffic volumes will vary from 6,730 VPH southbound between the I-90/Kneeland Street and I-90 (westbound) on-ramps, to 8,270 VPH southbound near the Leverett Circle on-ramp. Comparing volumes at peak load points for the 2010 baseline and Proposed Action in the AM peak hour, the Central Artery will carry 10 percent more vehicles in the northbound direction, and 50 percent more in the southbound direction, under the Proposed Action. In the PM peak hour, the Central Artery under the Proposed Action will carry 75 percent more peak hour traffic at its northbound peak load point, and 36 percent more at its southbound peak load point.

Table 3.10 also provides data on peak hour approach volumes for 48 strategic intersections in the study area. At a large majority of these intersections, the Proposed Action will result in reduced traffic volumes. In the AM peak hour, traffic volumes will decrease as a result of the Proposed Action at 22 (59 percent) of these intersections. In the PM peak hour, the Proposed Action will reduce traffic volumes at 30 (79 percent) of the intersections. Among the locations where traffic will decline are such major downtown intersections as Leverett Circle; Atlantic Avenue where it crosses Kneeland Street, Congress Street and Northern Avenue; Essex Street/Surface Artery; North Washington/Commercial Streets; and New Sudbury/Blackstone Streets. The majority of South Boston intersections included in the table also will experience reduced traffic during the AM peak hour as a result of the Proposed Action, and traffic will decline at all the South Boston intersections in the PM peak hour, except Andrew Square, where volumes will be essentially the same in both the 2010 baseline and Proposed Action conditions. In East Boston, traffic will be lower under the Proposed Action at virtually all the intersections included in the table, except Bennington Street/Neptune Road, and, in the PM peak hour, Porter/London Streets. Most of the intersections experiencing increased traffic volumes under the Proposed Action will be clustered in or near the Government Center area along Merrimack, Congress, and State Streets. As noted earlier, these traffic increases will be confined, in most cases, to the AM peak hour. On Purchase Street in the Financial District, traffic increases in both the AM and PM peak hours will occur because the roadway connects directly with off-ramps to Oliver and Summer Streets. Among all the intersections included in Table 3.10, total approach volumes will decrease by an average of 8.7 percent as a result of the Proposed Action.

3.2.4 Projected Traffic Operations

3.2.4(a) Projectwide Operating Characteristics

Overall, the Proposed Action will cause significant improvements in traffic operations and travel conditions, compared to the 2010 baseline case. In the absence of the Proposed Action, existing traffic problems would become much worse. The Proposed Action will alleviate the major existing deficiencies on the Central Artery and expand cross-harbor capacity. As a result, the highway system will be able to accommodate future traffic volumes with substantially less congestion and better traffic flow. The expansion and improvements on I-93 and I-90 will serve to divert traffic away from the local street system and onto the mainline highways.

In the Proposed Action case, traffic on most of the Central Artery, connecting segments of the Southeast Expressway, and the Sumner/Callahan Tunnels generally will function during both peak periods at LOS D to E, which represents slightly congested to at-capacity operations (see Table 3.11 and Figure 3.18). The only exceptions are the southbound segments upstream of the Leverett Circle on-ramp and the Oliver Street off-ramp. Both of these segments will operate in the AM peak hour only at LOS F, due to a merge where the Leverett Circle on-ramp enters the southbound mainline, and a weave upstream of the off-ramp to Oliver Street. This quality of operations is a substantial improvement compared to existing conditions and the travel conditions that would exist in the 2010 baseline case.

In the 2010 baseline condition, during both peak hours, virtually the entire Central Artery, its connecting segments of the Southeast Expressway, and Route 1A would operate at capacity to breakdown conditions (LOS E and F). The Sumner Tunnel would operate at LOS F during both the AM and PM peak periods, and the Callahan Tunnel would operate at LOS F in the AM peak hour. In some places, there is only a small margin for peak hour level of service to worsen since these segments are at or very near capacity at present. At major bottlenecks, of course, increase in traffic demand in the 2010 baseline case would result in significant increases in the length of, and time spent in, queues -- and the length of the peak traffic periods would grow from a maximum of 9 hours at present to 14 hours in 2010. Another consequence of projected increases in traffic volumes is that more traffic would use surface streets to avoid congestion on the Central Artery.

Another critical measure of traffic operations is speed. Table 3.11 shows that the Proposed Action will result in substantial improvements in operating speed on most segments of the Central Artery, relative to the 2010 baseline condition, at the same time that it carries much higher volumes of vehicle traffic. The speeds reported in the table incorporate the effects of delays related to gradients and converging streams of traffic, where merges, lane reductions, and weaves occur. (A discussion of the methods used to forecast such speed reductions is presented in the project Technical Report, Detailed Travel Model Documentation, June 1989.) Morning peak hour speeds in the northbound direction are forecast to be 41 mph on most sections of the Central Artery with the Proposed Action in place, except for the segment between the Sumner Tunnel on-ramp and the Route 1 off-ramp, which will be a 5.3 percent upgrade and operate with speeds of 22 mph. In contrast, the northbound AM peak operating speed on most of the Central Artery would be 29 mph in the 2010 baseline condition, and would decline to 9 mph on the segment approaching the Charles River bridge and the Leverett Circle on-ramp. In the southbound direction in the AM peak hour, most of the new Central Artery will operate in the range of 27 to 42 mph. A speed reduction to 11 mph will occur on the segment of I-93 upstream of the point where the Leverett Circle on-ramp merges with the southbound mainline. In the 2010 baseline condition, most of the Central Artery would operate southbound in the AM peak hour at speeds of 22 to 24 mph. Speeds on the approach to the Charles River bridge, extending upstream as far as the Tobin Bridge, would be only 12 mph, reflecting the convergence of traffic from five lanes on I-93 and Route 1 to only three lanes on the bridge over the Charles River.

The improvement in operating speeds resulting from the Proposed Action will be greater in the PM peak hour. In the northbound direction, speeds on most of the new Central Artery are forecast to range from 33 to 41 mph, with a reduction (to 12 mph) caused by the upgrade segment between the Sumner Tunnel on-ramp and the Route 1 off-ramp. The speed reduction on the I-93 mainline would extend 2600 feet upstream from the vicinity of the Sumner Tunnel

Table 3.11

PROJECTED TRAFFIC OPERATIONS IN 2010

Highway Links	Peak Hourly Volume (VPH)				Peak Hourly Speed (MPH)				Level of Service		
	No Build		Build		No Build		Build		No Build		Build
	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM
Northbound Links											
Southeast Expressway Between:											
NL1 Columbia Road Off- and On-Ramps	6,320	4,430	7,000	5,040	20	15	12	12	F	F	F
NL2 Columbia Road On-and Southampton Street Off-Ramps	7,890	5,450	7,860	5,820	11	15	32	31	F	F	E
NL3 Massachusetts Avenue and East Berkeley Street On-Ramps	5,390	3,500	N/A	N/A	12	11	N/A	N/A	F	F	N/A
NL4 Massachusetts Avenue and I-90 WB/Broadway Off-Ramps	N/A	N/A	7,100	5,080	N/A	N/A	38	45	N/A	N/A	E
NL5 I-90 WB/Broadway Off- and Massachusetts Avenue On-Ramps	N/A	N/A	4,710	3,530	N/A	N/A	31	38	N/A	N/A	E
NL6 Massachusetts Avenue On- and Third Harbor Tunnel (I-90 EB) Off-Ramps	N/A	N/A	6,020	5,300	N/A	N/A	36	38	N/A	N/A	E
NL7 East Berkeley Street On- and I-90/Kneeland Street Off-Ramps	6,260	4,510	N/A	N/A	26	7	N/A	N/A	F	F	N/A
NL8 I-90/Kneeland Street Off- and I-90/Broadway On-Ramps	4,590	2,310	N/A	N/A	24	4	N/A	N/A	F	F	N/A
NL9 I-90 EB Off- and I-90 WB On-Ramps	N/A	N/A	4,390	4,310	N/A	N/A	41	37	N/A	N/A	D
NL10 I-90 WB and I-90 EB/Broadway On-Ramps	N/A	N/A	4,710	5,150	N/A	N/A	41	37	N/A	N/A	D
Central Artery Between:											
NL11 South Street On- and Northern Avenue Off-Ramps	6,890	4,850	N/A	N/A	25	6	N/A	N/A	F	F	N/A
NL12 Congress Street On- and Northern Avenue Off-Ramps	6,120	3,980	N/A	N/A	21	6	N/A	N/A	F	F	N/A
NL13 Northern Avenue On- and Callahan Tunnel Off-Ramps	6,750	4,830	N/A	N/A	25	9	N/A	N/A	F	F	N/A
NL14 Callahan Tunnel Off- and Sumner Tunnel On-Ramps	4,870	3,420	N/A	N/A	29	7	N/A	N/A	F	F	N/A
NL15 North Street Off- and Essex Street/Northern Avenue On-Ramps	N/A	N/A	4,820	5,410	N/A	N/A	41	37	N/A	N/A	D
NL16 Essex Street/Northern Avenue and and Sumner Tunnel On-Ramps	N/A	N/A	6,460	7,470	N/A	N/A	41	12	N/A	N/A	D
NL17 Sumner Tunnel On- and Causeway Street Off-Ramps	6,460	4,550	N/A	N/A	29	7	N/A	N/A	F	F	N/A
NL18 Sumner Tunnel On- and Route 1 Off-Ramps	N/A	N/A	7,550	8,470	N/A	N/A	22	12	N/A	N/A	F
NL19 Storrow Drive Off- and On-Ramps	3,620	3,400	N/A	N/A	9	6	N/A	N/A	F	F	N/A
NL20 Storrow Drive On- and Route 1 (Tobin Bridge) Off-Ramps	5,780	6,200	N/A	N/A	29	27	N/A	N/A	F	F	N/A
NL21 Valenti Way/City Square and Leverett Circle On-Ramps	N/A	N/A	3,910	5,380	N/A	N/A	43	33	N/A	N/A	D
NL22 I-93 Between Route 1 Ramps	2,600	3,100	3,140	3,880	47	45	43	33	B	C	C
NL23 I-93 North of Route 1 Interchange	3,260	4,460	5,020	6,650	47	45	43	33	B	C	C
NL24 Route 1 North of I-93 Ramps	3,800	4,430	3,400	4,610	41	38	44	35	D	E	D
Route 1A Between:											
NL25 Toll Plaza and Logan Airport Off-Ramp	3,180	3,490	2,170	3,100	29	29	46	44	E	E	B
NL26 Logan Airport On- and Neptune Road Off-Ramps	3,650	4,380	N/A	N/A	36	23	N/A	N/A	D	F	N/A
NL27 I-90 EB (Third Harbor Tunnel) On- and Neptune Road Off-Ramps	N/A	N/A	940	1,840	N/A	N/A	33	16	N/A	N/A	N/A
NL28 Route 1A North of Neptune Road Off-Ramp	N/A	N/A	2,520	3,910	N/A	N/A	33	27	N/A	N/A	E
NL29 Callahan Tunnel	3,410	3,940	2,380	3,420	37	27	44	35	E	F	C

Table 3.11 (Cont.)

PROJECTED TRAFFIC OPERATIONS IN 2010

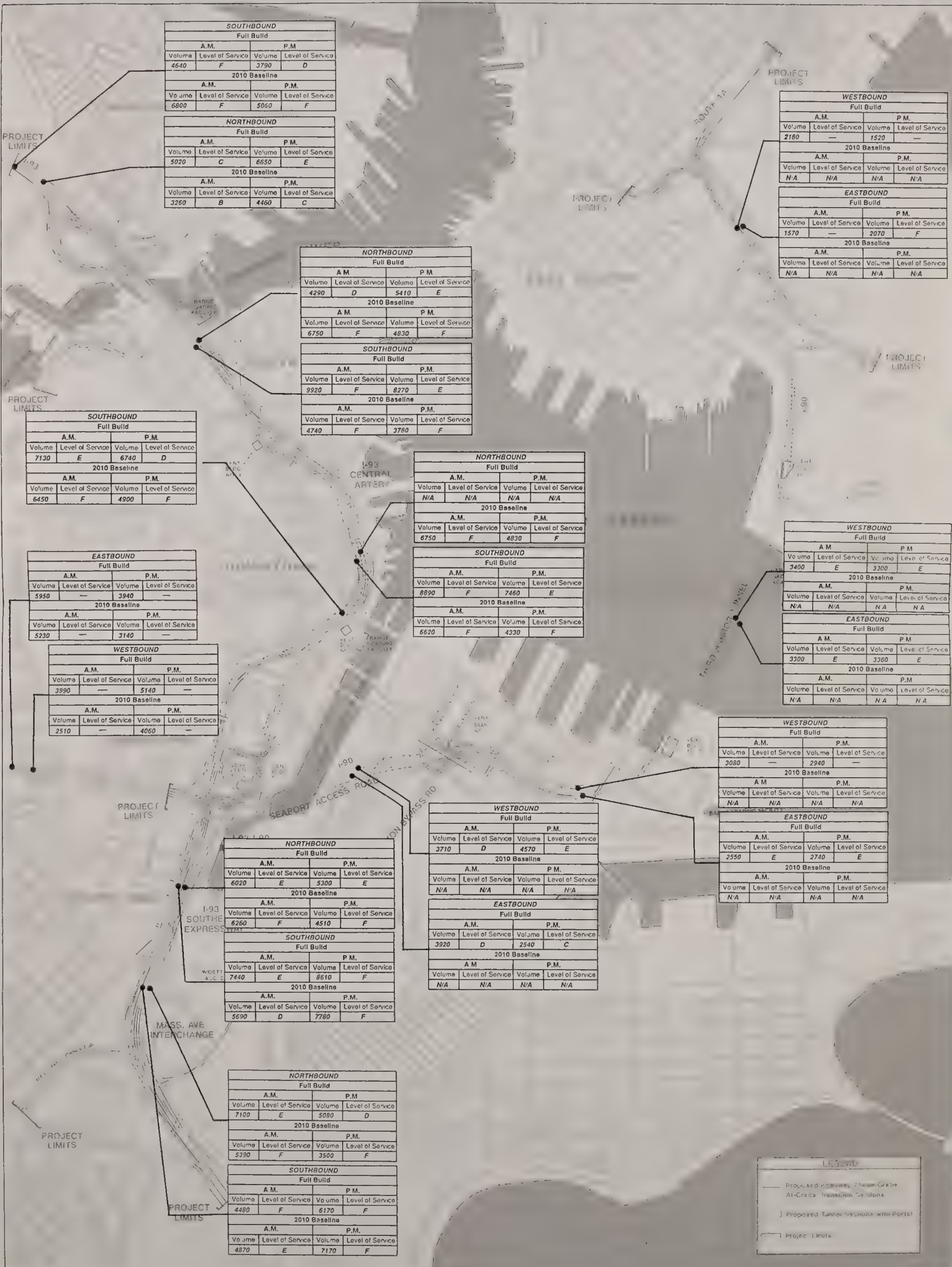
Highway	Links	Peak Hourly Volume (VPH)				Peak Hourly Speed (MPH)				Level of Service			
		No Build		Build		No Build		Build		No Build		Build	
		AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Southbound Links													
Southeast Expressway Between:													
SL1	Southampton Street On- and Columbia Road Off-Ramps	5,050	7,840	5,910	7,960	44	27	32	32	D	F	E	E
SL2	Boston St. Off- and Southampton Street/Massachusetts Avenue On-Ramps	N/A	N/A	4,480	6,170	N/A	N/A	15	12	N/A	N/A	F	F
SL3	Boston Street Off- and Southampton Street On-Ramps	4,870	7,170	N/A	N/A	35	28	N/A	N/A	E	F	N/A	N/A
SL4	Massachusetts Avenue On- and Boston Street Off-Ramps	5,430	7,850	N/A	N/A	35	28	N/A	N/A	E	F	N/A	N/A
SL6	Massachusetts Avenue Off- and On-Ramps	4,680	6,710	N/A	N/A	36	13	N/A	N/A	E	F	N/A	N/A
SL7	East Berkeley/Albany Streets On- and Massachusetts Avenue Off-Ramps	5,690	7,780	N/A	N/A	42	11	N/A	N/A	D	F	N/A	N/A
SL8	I-90 WB On- and Massachusetts Avenue Off-Ramps	N/A	N/A	7,440	8,610	N/A	N/A	34	12	N/A	N/A	E	F
SL9	East Barrel between Essex Street On-Ramp and Central Artery West Barrel	N/A	N/A	3,120	3,860	N/A	N/A	42	15	N/A	N/A	D	F
SL10	West Barrel between Congress St. On- and I-90 WB/Albany Street Off-Ramps	N/A	4,180	4,480	N/A	N/A	38	38	N/A	N/A	E	E	
Central Artery Between:													
SL11	I-90/Kneeland Street On- and East Berkeley Street Off-Ramps	5,870	5,810	N/A	N/A	34	9	N/A	N/A	F	F	N/A	N/A
SL13	Beach Street and I-90/ Broadway Off-Ramps	5,700	5,690	N/A	N/A	28	12	N/A	N/A	F	F	N/A	N/A
SL14	Congress Street On- and Beach Street Off-Ramps	6,090	6,080	N/A	N/A	28	8	N/A	N/A	E	F	N/A	N/A
SL15	Purchase Street On- and Dewey Square (Summer Street) Off-Ramps	6,450	4,900	N/A	N/A	23	7	N/A	N/A	F	F	N/A	N/A
SL16	Oliver Street and Dewey Square (Summer Street) Off-Ramps	N/A	N/A	7,340	6,740	N/A	N/A	35	38	N/A	N/A	E	E
SL17	Haymarket On- and High Street Off-Ramps	6,630	4,430	N/A	N/A	30	7	N/A	N/A	F	F	N/A	N/A
SL18	New Chardon Street On- and Oliver Street Off-Ramps	N/A	N/A	8,890	7,460	N/A	N/A	28	30	N/A	N/A	F	E
SL19	Callahan Tunnel Off- and Haymarket On-Ramps	5,030	3,550	N/A	N/A	22	6	N/A	N/A	F	F	N/A	N/A
SL20	Causeway Street On- and Callahan Tunnel Off-Ramps	6,280	4,630	N/A	N/A	27	16	N/A	N/A	F	F	N/A	N/A
SL21	Leverett Circle On- and Callahan Tunnel/Clinton Street Off-Ramps	N/A	N/A	9,920	8,270	N/A	N/A	28	36	N/A	N/A	F	E
SL22	Leverett Circle On- and Haymarket Off-Ramps	4,740	3,780	N/A	N/A	30	15	N/A	N/A	F	F	N/A	N/A
SL23	Route 1 SB (Tobin Bridge) On- and Leverett Circle Off-Ramps	5,470	5,500	N/A	N/A	12	15	N/A	N/A	F	F	N/A	N/A
SL24	Route 1 SB (Tobin Bridge) and Leverett Circle On-Ramps	N/A	N/A	8,210	6,470	N/A	N/A	11	32	N/A	N/A	F	E
SL25	I-93 Between Route 1 Ramps	3,200	2,670	4,630	3,330	12	13	11	35	F	F	F	D
SL26	I-93 North of Tobin Bridge Ramps	4,650	3,590	6,800	54,060	12	13	11	45	F	F	F	D
SL2[illegible]	Mystic Tobin Bridge (Route 1) North of I-90 Ramps	3,380	3,260	4,110	3,420	12	27	40	44	E	E	D	C

Table 3.11 (Cont.)

PROJECTED TRAFFIC OPERATIONS IN 2010

Highway Links	Peak Hourly Volume (VPH)				Peak Hourly Speed (MPH)				Level of Service		
	No Build		Build		No Build		Build		No Build		Build
	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM
Route 1A Between:											
SL29 Logan Airport Off- and On-Ramps	3,350	2,370	1,110	1,150	10	6	40	40	F	F	N/A
SL30 I-90 WB (Third Harbor Tunnel) and Airport Off-Ramps	2,060	1,880	N/A	N/A	24	27	N/A	N/A	F	F	N/A
SL31 Neptune Road On- and I-90 WB (Third Harbor Tunnel) Off-Ramps	N/A	N/A	4,240	3,390	N/A	N/A	24	27	N/A	N/A	F
SL32 Neptune Road On- and Logan Airport Off-Ramps	4,240	3,780	N/A	N/A	27	9	N/A	N/A	F	F	N/A
SL34 Sumner Tunnel (Route 1A)	3,800	2,580	3,030	2,650	20	12	33	32	F	F	E
Eastbound Links											
I-90 Between:											
EL3 I-93 On- and Congress Street Off-Ramps	N/A	N/A	3,920	2,540	N/A	N/A	40	44	N/A	N/A	D
EL3A Congress Street Off- and On-Ramps	N/A	N/A	1,670	1,190	N/A	N/A	34	14	N/A	N/A	E
EL4 Congress Street and I-90 C/D On-Ramps	N/A	N/A	2,550	2,740	N/A	N/A	34	14	N/A	N/A	E
EL5 Third Harbor Tunnel (I-90 C/D On- to Logan Airport Off-Ramps)	N/A	N/A	3,300	3,360	N/A	N/A	37	32	N/A	N/A	E
EL6 Logan Airport Off-Ramp to Route 1A	N/A	N/A	1,570	2,070	N/A	N/A	33	16	N/A	N/A	N/A
I-90 C/D Between:											
EL7 Albany Street On- and Massport Haul Road Off-Ramps	N/A	N/A	1,570	1,750	N/A	N/A	46	46	N/A	N/A	B
Westbound Links											
I-90 Between:											
WL3 West Service Road On- and I-93 Off-Ramps	N/A	N/A	3,710	4,570	N/A	N/A	41	34	N/A	N/A	D
WL4 Massport Haul Road On- and West Service Road On-Ramps	N/A	N/A	3,310	3,850	N/A	N/A	41	34	N/A	N/A	D
WL5 Congress Street Off- and C Street /Massport Haul Road On-Ramps	N/A	N/A	2,220	2,240	N/A	N/A	35	13	N/A	N/A	E
WL7 Third Harbor Tunnel (Airport On-(Ramp and I-90 C/D Off-Ramp)	N/A	N/A	3,400	3,330	N/A	N/A	30	35	N/A	N/A	E
WL8 Route 1A SB Diverge and Toll Plaza	N/A	N/A	2,180	1,520	N/A	N/A	20	17	N/A	N/A	N/A
I-90 C/D Between:											
WL11 Congress Street On- and South Station Off-Ramps	N/A	N/A	730	850	N/A	N/A	40	41	N/A	N/A	A

Source: Bechtel/Parsons Brinckerhoff



SOUTHBOUND

	A.M. Volume	A.M. Level of Service	P.M. Volume	P.M. Level of Service
Full Build	4640	F	3790	D
2010 Baseline	6800	F	5060	F

NORTHBOUND

	A.M. Volume	A.M. Level of Service	P.M. Volume	P.M. Level of Service
Full Build	5020	C	6650	E
2010 Baseline	3260	B	4460	C

WESTBOUND

	A.M. Volume	A.M. Level of Service	P.M. Volume	P.M. Level of Service
Full Build	2180	—	1520	—
2010 Baseline	N/A	N/A	N/A	N/A

EASTBOUND

	A.M. Volume	A.M. Level of Service	P.M. Volume	P.M. Level of Service
Full Build	1570	—	2070	F
2010 Baseline	N/A	N/A	N/A	N/A

NORTHBOUND

	A.M. Volume	A.M. Level of Service	P.M. Volume	P.M. Level of Service
Full Build	4290	D	5410	E
2010 Baseline	6750	F	4830	F

SOUTHBOUND

	A.M. Volume	A.M. Level of Service	P.M. Volume	P.M. Level of Service
Full Build	9920	F	8270	E
2010 Baseline	4740	F	3780	F

SOUTHBOUND

	A.M. Volume	A.M. Level of Service	P.M. Volume	P.M. Level of Service
Full Build	7130	E	6740	D
2010 Baseline	6450	F	4900	F

NORTHBOUND

	A.M. Volume	A.M. Level of Service	P.M. Volume	P.M. Level of Service
Full Build	N/A	N/A	N/A	N/A
2010 Baseline	6750	F	4830	F

SOUTHBOUND

	A.M. Volume	A.M. Level of Service	P.M. Volume	P.M. Level of Service
Full Build	8890	F	7460	E
2010 Baseline	6620	F	4330	F

EASTBOUND

	A.M. Volume	A.M. Level of Service	P.M. Volume	P.M. Level of Service
Full Build	5950	—	3940	—
2010 Baseline	5230	—	3140	—

WESTBOUND

	A.M. Volume	A.M. Level of Service	P.M. Volume	P.M. Level of Service
Full Build	3990	—	5140	—
2010 Baseline	2510	—	4060	—

WESTBOUND

	A.M. Volume	A.M. Level of Service	P.M. Volume	P.M. Level of Service
Full Build	3400	E	3300	E
2010 Baseline	N/A	N/A	N/A	N/A

EASTBOUND

	A.M. Volume	A.M. Level of Service	P.M. Volume	P.M. Level of Service
Full Build	3300	E	3360	E
2010 Baseline	N/A	N/A	N/A	N/A

WESTBOUND

	A.M. Volume	A.M. Level of Service	P.M. Volume	P.M. Level of Service
Full Build	3080	—	2940	—
2010 Baseline	N/A	N/A	N/A	N/A

EASTBOUND

	A.M. Volume	A.M. Level of Service	P.M. Volume	P.M. Level of Service
Full Build	2550	E	2740	E
2010 Baseline	N/A	N/A	N/A	N/A

WESTBOUND

	A.M. Volume	A.M. Level of Service	P.M. Volume	P.M. Level of Service
Full Build	3710	D	4570	E
2010 Baseline	N/A	N/A	N/A	N/A

EASTBOUND

	A.M. Volume	A.M. Level of Service	P.M. Volume	P.M. Level of Service
Full Build	3920	D	2540	C
2010 Baseline	N/A	N/A	N/A	N/A

NORTHBOUND

	A.M. Volume	A.M. Level of Service	P.M. Volume	P.M. Level of Service
Full Build	6020	E	5300	E
2010 Baseline	6260	F	4510	F

SOUTHBOUND

	A.M. Volume	A.M. Level of Service	P.M. Volume	P.M. Level of Service
Full Build	7440	E	8610	F
2010 Baseline	5690	D	7780	F

NORTHBOUND

	A.M. Volume	A.M. Level of Service	P.M. Volume	P.M. Level of Service
Full Build	7100	E	5080	D
2010 Baseline	5290	F	3500	F

SOUTHBOUND

	A.M. Volume	A.M. Level of Service	P.M. Volume	P.M. Level of Service
Full Build	4480	F	6170	F
2010 Baseline	4870	E	7170	F

FIGURE 3.18

Overview Of Traffic Operating Conditions: 2010 Baseline And Proposed Action

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entrance ramp. In the 2010 baseline condition, the entire northbound Central Artery upstream of the Leverett Circle on-ramp, as well as northern segments of the Southeast Expressway,would operate at speeds of only 6 to 7 mph. The speed on the segment north of the Leverett Circle on-ramp would be 27 mph. In the southbound direction, most of the Central Artery will operate at speeds ranging from 30 to 38 mph with the Proposed Action in place. The exception will be the segment immediately south of the Kneeland Street tunnel portal where the lanes from the two halves of the existing Dewey Square Tunnel will merge, and drop one lane, causing a speed reduction of 15 mph, backing up towards the Essex Street southbound on-ramp. In contrast, southbound PM peak hour speeds in the 2010 baseline condition would range from 6 to 12 mph on the entire Central Artery south of the Callahan Tunnel off-ramp, due primarily to severe upstream congestion on the Southeast Expressway. North of the Callahan Tunnel exit, the highway would operate at speeds of 15 to 16 mph.

The marked improvement associated with the Proposed Action is due both to the expansion of capacity and reduction of weaving movements generally, and to alleviation of specific operational bottlenecks. In the northbound direction, the Proposed Action will eliminate the severe bottleneck at the Charles River bridge approach. Major obstructions of traffic flow also will be alleviated in the southbound direction at the Massachusetts Avenue interchange on the Southeast Expressway and the Dewey Square tunnel entrance.

Regarding traffic conditions on ramps, highway alignment modifications in the Proposed Action will result in the elimination of some existing ramp control areas and the creation of new entry/exit points. For consistency with previous analyses, the levels of service were determined for those locations where ramp geometrics (in either the 2010 baseline or Proposed Action) constrain movements or cause congestion. (Table 3.12 presents information on ramp operating conditions; for the Proposed Action, the table distinguishes those ramps that enter the mainline by a lane addition from those that merge with the mainline lanes). Some of the ramp areas of the Central Artery/Southeast Expressway/I-90 alignments will operate at LOS F in the AM and/or PM peak hours. These include the entrance ramps from Congress Street (southbound), Essex Street/Northern Avenue (northbound), and I-90/Frontage Road (northbound). At Congress Street, ramp traffic will back up in the PM peak hour to the Congress/Purchase Street intersection. No impact to intersection operations is forecast in the AM peak hour. There also will be a negative impact associated with ramp operations in the PM peak hour only at the Essex Street/South Street and Northern/Atlantic Avenue intersections, as a result of spillback from the Essex Street/Northern Avenue entrance ramp. At the I-90/Frontage Road entrance ramp, traffic will spill back to the Broadway/Frontage Road intersection in the AM peak hour only. The majority of ramp areas shown in the table will operate at an acceptable level of service, as will all the ramp areas not included in the table. In the 2010 baseline case, operations at critical ramps would deteriorate from the existing LOS D to F range to breakdown level F conditions at all locations analyzed, except for the Southampton Street on-ramp on the Southeast Expressway in the AM peak hour, which would operate at LOS D, and the Massachusetts Avenue on-ramp in the PM peak hour, which would operate at LOS E.

Because the Proposed Action will alleviate existing bottlenecks on the expressway system in the study area, traffic flows to connecting radial routes outside the study area will increase somewhat. Increased congestion at bottleneck locations outside the study area may result, as traffic is diverted away from local streets and arterials and attracted to the expressway system at these locations. The analysis of impacts outside the study area is underway; the results will be available in a project technical report.

Table 3.12

TRAFFIC OPERATIONS AT CRITICAL RAMP AREAS

Location	Lane 1 Merge Volume (pcph) AM	PM	Level of Service AM	PM
PROPOSED ACTION				
I-93 Northbound Merges				
Columbia Road On, to Southeast Expressway	>2,000	>2,000	F	F
I-90 WB (Ramp DN) On, to Central Artery	1,430	1,970	C	E
I-90 (Ramp DN) On, to Central Artery	1,430	1,970	C	E
Valenti Way/City Square/Route 1 On, to I-93	1,560	>2,000	D	F
I-93 Southbound Merges				
Leverett Circle On, to Central Artery	>2,000	>2,000	F	F
Southampton Street On, to Central Artery	>2,000	>2,000	F	F
I-93 Northbound Lane Additions				
Massachusetts Avenue On, to Southeast Expressway	1,400	1,890	C	E
I-90/Frontage Road On, to Central Artery	>2,000	>2,000	F	F
Northern Avenue/Essex Street On, to Central Artery	1,760	>2,000	E	F
Sumner Tunnel On, to Central Artery	1,160	1,070	C	C
Leverett Circle On, to Central Artery	1,190	1,350	C	C
I-93 Southbound Lane Additions				
Congress Street On, to Central Artery	1,200	>2,000	C	F
Essex Street On, to Central Artery	110	710	A	B
I-90 EB/Kneeland On, to Central Artery	1,540	1,480	D	D
I-90 WB/Herald On, to Central Artery	1,250	1,530	C	D
I-90 Eastbound Merges				
Albany Street On, to I-90 C/D	1,080	1,100	C	C
South Boston Bypass Road On, to I-90 C/D	810	670	B	B
Congress Street On, to I-90	1,610	>2,000	D	F
I-90 C/D On, to I-90	1,830	1,780	E	E
I-90 Westbound Merges				
Airport On, to I-90	1,850	1,980	E	E
Massport Haul Road On, to I-90	>2,000	>2,000	F	F
West Service Road On, to I-90 C/D	510	670	B	B
I-93 NB On, to I-90	1,430	1,970	C	E

Table 3.12 (Cont.)

TRAFFIC OPERATIONS AT CRITICAL RAMP AREAS

Location	Lane 1 Merge Volume (pcph) AM	PM	Level of Service AM	PM
2010 BASELINE				
Northbound				
Columbia Road On, to Southeast Expressway	>2,000	*	F	*
East Berkeley Street On, to Central Artery	>2,000	*	F	*
I-90 (Turnpike) On, to Central Artery	>2,000	*	F	*
Congress Street On, to Central Artery	>2,000	*	F	*
Northern Avenue On, to Central Artery	>2,000	*	F	*
Leverett Circle On, to Central Artery	>2,000	>2,000	F	F
Southbound				
Haymarket/Sumner Tunnel On, to Southeast Expressway	>2,000	*	F	*
Massachusetts Avenue On, to Southeast Expressway	1,850	N/A	E	N/A
Southampton Street On, to Central Artery	1,630	>2,000	D	F

1. Ramp congestion due to downstream obstruction
2. N/A: Not applicable

Source: Bechtel/Parsons Brinckerhoff

Intersection Operations. Operations at 45 critical intersections were examined to determine the impacts of the project on surface street traffic conditions. (The locations of these intersections are shown in Figure 3.19; the results of this analysis are summarized in Table 3.13.) The intersections selected for analysis are those that were judged to be most sensitive to project-related traffic impacts, and generally are adjacent to the alignment and its entrance/exit ramps. Some locations analyzed in conjunction with the Proposed Action do not coincide geographically and operationally exactly with intersections analyzed in the existing base year or future baseline conditions because several existing intersections will be modified or eliminated in the Proposed Action condition, while other intersections are to be newly created. Among the 29 intersections that are comparable in the 2010 baseline and Proposed Action conditions, 12 would operate with one or more approaches at LOS F in the AM peak hour, and 13 would operate with at least one approach at LOS F in the PM peak hour, in the 2010 baseline condition. In comparison, under the Proposed Action, there will be only seven and eight intersections operating at LOS F in the AM and PM peak hours, respectively.

The improvement resulting from the Proposed Action will be greater in the PM peak hour, because traffic conditions in downtown Boston would be worse in the PM peak than the AM peak in the 2010 baseline condition. Traffic volumes on downtown streets would be constrained in the AM peak hour under the 2010 baseline, due to a lack of highway capacity at entrance points to the downtown area. Traffic during the AM peak hour in effect would be metered at these entrance points, with the peak spread over several hours of the day, such that the total volume of traffic downtown would be lower than in the PM peak hour. Conversely, PM peak hour traffic would be metered as it attempted to leave the downtown area, resulting in a large build-up of traffic on City streets.

In the PM peak hour, the Proposed Action will improve traffic operations at 15 of the intersections analyzed, and will have negative impacts at only seven. The locations where improvements will occur tend to be major intersections processing large volumes of traffic, including Leverett Circle, Atlantic/Northern Avenues, Atlantic Avenue/Congress Street, Albany/Herald Streets, and Bennington Street/Neptune Road. These intersections generally would operate at LOS F in the 2010 baseline, but will improve to a substantially better LOS under the Proposed Action. In comparison, the intersections that the project will affect adversely tend to be directly in the path of entrance/exit ramps; they also tend to operate relatively well (LOS B and C) in both the 2010 baseline and Proposed Action conditions. The only locations where the project will have a negative impact that results in some LOS F operations are on Purchase Street at the intersections of Congress (PM only) and Summer Streets. These two intersections are immediately downstream of the Oliver Street off-ramp; in addition, another off-ramp feeds into the Summer/Purchase Streets intersection.

The Proposed Action will result in improved operations in the AM peak hour at 13 intersections, while negative impacts will occur at 13 other intersections. Once again, the improved locations tend to be strategic intersections. Among the locations where there will be negative impacts, only the Purchase/Summer Streets intersection will operate at LOS F, while most will continue to operate in the LOS B to D range.

Overall, with the Proposed Action in place, most intersections will operate at an acceptable level by urban standards, with some congestion, as reflected in one or more approaches being at LOS D or E. Many of the intersections, however, will operate at LOS C or better.

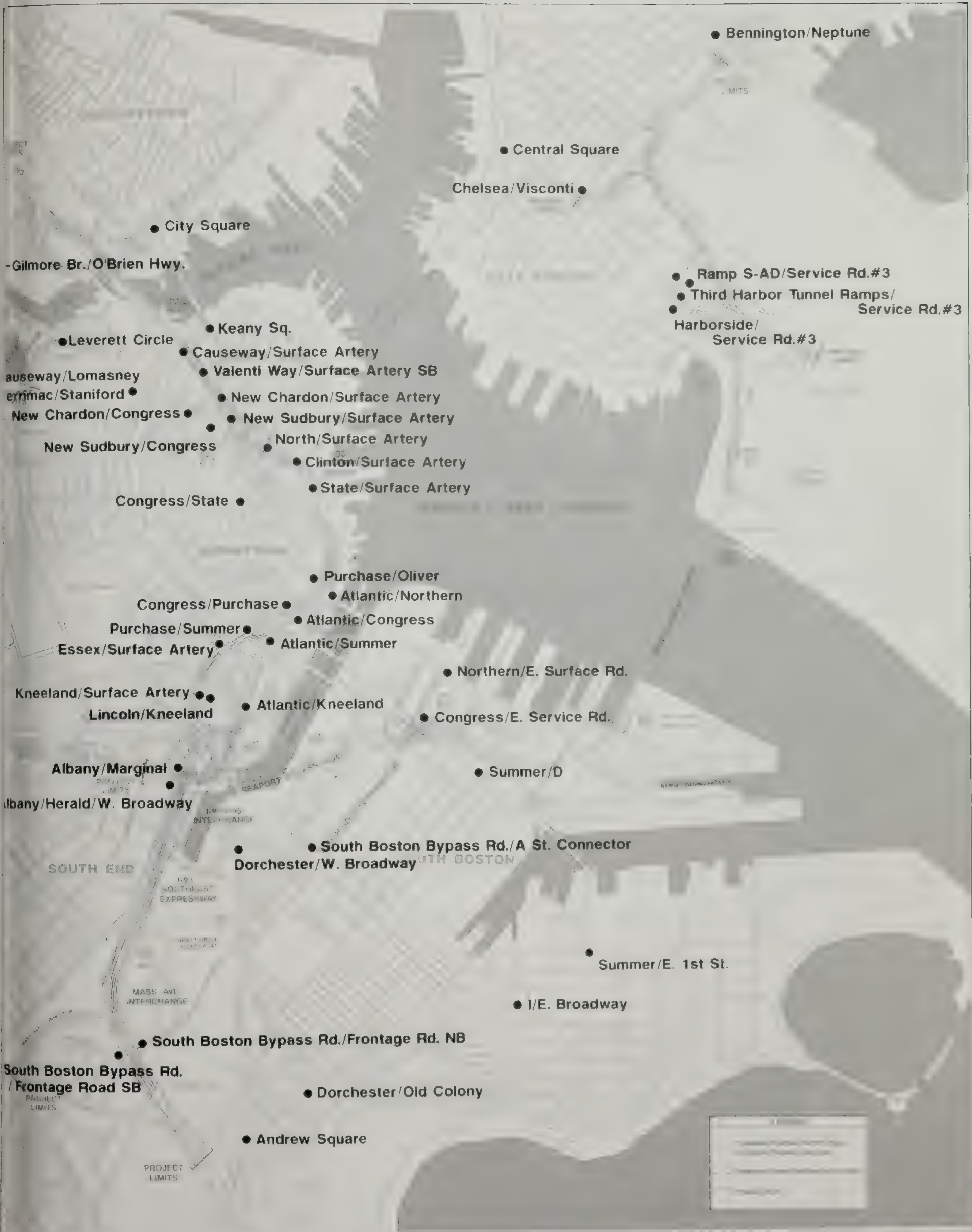

FIGURE 3.19 **Intersection Analysis Sites**

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Table 3.13

PROJECTED TRAFFIC OPERATIONS AT SIGNALIZED INTERSECTIONS

Location	Approach	Approach Delay (sec/veh) Future Baseline AM	Future Baseline PM	Proposed Action AM	Proposed Action PM	Volume-to-Capacity Ratio Future Baseline AM	Future Baseline PM	Proposed Action AM	Proposed Action PM	Level of Service Future Baseline AM	Future Baseline PM	Proposed Action AM	Proposed Action PM
North of Causeway													
1 City Square	I-93 Exit EB	>100	>100	>100	65	0.87/1.63	0.77/1.62	1.15	1.04	F	F	F	F
	Chelsea WB	>100	>100	>100	73	1.54/0.43/0.55	1.51/1.12/0.37	1.15	1.04	F	F	F	F
	N. Washington NB	>100	>100	34	50	1.39/0.96	1.51/1.51	0.13/0.57/0.36	0.87/0.98/0.65	F	F	D	F
	Rutherford SB	>100	94	83	49	1.54/1.54	1.12/0.66/1.20	1.15/1.15/0.60	1.04/1.04/0.77	F	F	F	E
2 Leverett Circle	Charles River Dam EB	>100	>100	38	19	1.34/1.46	0.85/1.25	1.01/1.02	0.90/0.94	F	F	B	C
	Charles (Storrow) NB	>100	75	52	20	1.27/1.46/0.04	1.25/0.92/0.03	0.63/1.11	0.97/0.74	F	F	E	C
	Nashua SB	33	>100	45	24	0.62	0.92/1.60	1.02	0.94	D	F	E	C
Cambridge													
3 Gilmore Bridge/ O'Brien Highway	Commercial EB	>100	>100	>100	>100	1.23	0.86/1.21	1.30	0.84/1.18	F	F	F	F
	Gilmore WB	>100	>100	>100	>100	1.23	1.21	1.35	1.18	F	F	F	F
	Charles Riv Dam NB	>100	>100	>100	>100	1.23/1.10	0.62/1.21/0.44	1.39/0.59	1.18/0.86	F	F	F	F
	O'Brien Higway SB	>100	>100	>100	>100	1.23	1.21	1.30	1.18	F	F	F	F
Central Area													
4 Keany Square	Causeway EB	>100	>100	78	64	1.82/0.77	2.42/0.39/0.45	1.11	1.28	F	F	F	F
	Commercial WB	>100	>100	58	45	0.11/0.98/1.82	0.26/0.48/2.42	1.11	1.28	F	F	E	E
	N. Washington NB	24	>100	31	39	0.68	2.42	1.11	0.45/1.28	C	F	D	D
	Charlestown Br SB	>100	>100	32	36	1.82/1.82/1.66	2.42/2.34/1.17	1.11	1.06/1.28	F	F	D	D
5 Causeway/Lomasney/ Merrimac/Staniford	Staniford NEB	23	35	37	17	0.58/0.79	0.94/0.88	0.78/0.98	0.36/0.74	C	D	D	C
	Causeway SWB	29	30	34	29	0.87/0.62	0.68/0.67	0.93/0.76	0.21/0.84	D	D	D	D
	Merrimac NWB	38	35	53	23	0.64/0.79	0.87/0.92	1.04/0.71	0.60/0.49	D	D	E	C
	Lomasney SEB	29	31	50	26	0.86/0.63	0.60/0.88	1.05/0.98	0.87/0.74	D	D	E	D
6 Causeway/Surface Artery SB (NEW)	Causeway EB	NA	NA	10	12	NA	NA	0.06	0.71	N/A	N/A	B	B
	Causeway WB	NA	NA	23	16	NA	NA	0.06/0.99	0.71/0.92	N/A	N/A	C	C
7 New Chardon/ Surface Artery	Cross WB	77	17	NA	NA	1.08	0.78	NA	NA	F	C	N/A	N/A
	N. Washington SB	43	7	NA	NA	0.26/1.08	0.55/0.78	NA	NA	E	B	N/A	N/A
	N. Washington NB	4	5	NA	NA	0.29	0.64	NA	NA	A	B	N/A	N/A
	New Chardon EB	NA	NA	17	36	NA	NA	0.68	1.01	N/A	N/A	C	D
	Sumner Tunnel NWB	NA	NA	59	17	NA	NA	1.08	0.73	N/A	N/A	E	C
	Surface Artery SB	NA	NA	28	28	NA	NA	0.86/1.10	1.01/0.37	N/A	N/A	D	D
	Sumner Tunnel NEB	NA	NA	15	34	NA	NA	0.50	0.92	N/A	N/A	B	D
	Surface Artery NB	NA	NA	18	9	NA	NA	0.92	0.84	N/A	N/A	C	C
8 New Sudbury/Surface Artery NB	New Sudbury EB	NA	NA	23	20	NA	NA	0.44	0.56	N/A	N/A	C	C
	Surface Artery NB	NA	NA	6	9	NA	NA	0.44	0.56	N/A	N/A	B	B
9 Congress/New Chardon	WB	15	19	48	19	0.70	0.68	1.03/1.05	0.32/0.86	B	B	E	C
	NB	19	12	30	16	0.57	0.66	1.05/1.03/0.72	0.42/0.54/1.00	C	B	D	C
	SB	21	14	45	25	0.70/0.50	0.61/0.50	1.05/0.44	0.68	C	B	E	D
10 Congress/Sudbury	EB	27	30	30	31	0.77/0.82	0.97/0.95/0.81	0.86/0.76/0.94	0.98/0.91/0.79	D	D	D	D
	NB	23	40	27	30	0.65	0.97	0.94	0.78/0.98	C	E	D	D
	SB	32	41	32	37	0.82/0.82	0.94/0.87	0.94/0.87	0.87/0.60	D	E	D	D
11 State/Congress	State WB	15	29	30	30	0.70	0.95	0.80	0.60	C	D	D	D
	Congress NB	13	25	23	19	0.41	0.95	0.57	0.60	B	C	C	C
	Congress SB	9	8	15	19	0.57/0.70	0.57/0.67	0.42/0.80	0.50/0.42	B	B	C	B
12 Surface Artery SB/ Valenti Way	SB	–	–	27	14	–	–	0.98	0.77	–	–	D	B
	WB	–	–	36	19	–	–	0.98	0.77	–	–	D	C

Table 3.13 (Cont.)

PROJECTED TRAFFIC OPERATIONS AT SIGNALIZED INTERSECTIONS

		Approach Delay (sec/veh)				Volume-to-Capacity Ratio				Level of Service			
		Future Baseline		Proposed Action		Future Baseline		Proposed Action		Future Baseline		Proposed Action	
Location	Approach	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
13 Clinton/Surface Artery	Clinton WB	35	86	NA	NA	0.76	1.11/1.01	NA	NA	D	F	NA	NA
	Surface Artery NB	16	28	NA	NA	0.91/0.36	1.02/0.93	NA	NA	C	D	NA	NA
	Surface Artery SB	24	39	NA	NA	0.93/0.34	1.18/0.97	NA	NA	C	D	NA	NA
Surface Artery SB/ Atlantic Connector	Atlantic Conn. WB	NA	NA	31	24	NA	NA	0.87	0.64	NA	NA	D	C
	Surface Artery SB	NA	NA	25	19	NA	NA	0.87	0.64	NA	NA	D	C
14 State/Surface Artery SB	State WB	21	>100	64	36	0.57	1.22	0.95	0.66	C	F	E	D
	Surface Artery SB	9	53	34	10	0.44	1.22/0.66	1.04	0.66	B	E	E	B
	Surface Artery NB	11	>100	NA	NA	0.57	1.22	NA	NA	B	F	NA	NA
15 North/Surface Artery /I-93 NB Exit	North EB	NA	NA	13	15	NA	NA	0.16	0.36	NA	NA	B	B
	I-90 Exit NWB	NA	NA	22	17	NA	NA	0.81	0.58	NA	NA	C	C
	Surface Artery SB	NA	NA	17	17	NA	NA	0.45/0.82	0.43/0.44	NA	NA	C	C
	Surface Artery NB	NA	NA	14	17	NA	NA	0.68	0.77	NA	NA	B	C
16 Atlantic/Northern	Central Artery Off	>100	>100	NA	NA	1.26	1.26	NA	NA	F	F	NA	NA
	Northern WB	>100	>100	31	41	1.26	1.26	0.71/0.95	0.65/0.98	F	F	D	E
	Atlantic NB	>100	>100	39	38	1.26	1.26	0.95	0.98	F	F	D	D
	Oliver SB	NA	NA	17	21	NA	NA	0.95/0.45	0.98/0.47	NA	NA	C	C
17 Purchase/Oliver	Oliver EB	NA	NA	196	245	NA	NA	0.45/1.39	0.36/1.45	NA	NA	F	F
	Ramp WB	NA	NA	297	383	NA	NA	1.39	1.45	NA	NA	F	F
	Purchase SB	NA	NA	243	335	NA	NA	1.39/1.26	1.13/1.45	NA	NA	F	F
18 Purchase/Congress	Purchase SWB	17	23	27	>100	0.73/0.38	0.93/0.70	0.98	1.19	B	C	D	F
	Congress SEB	11	23	34	>100	0.73	0.93	0.69/0.99/0.88	0.97/1.22/1.18	C	C	D	F
19 Atlantic/Congress	Congress SEB	>100	>100	23	23	1.51/0.73	1.25/0.48	0.95/0.70	0.92/0.51	F	F	C	C
	Congress NWB	>100	>100	38	38	1.51	1.25/1.76	0.95	0.92	F	F	D	D
	Atlantic NEB	>100	>100	36	39	1.51/0.07	1.25	0.95	0.92	F	F	D	D
20 Purchase/Summer	Summer NWB	12	17	77	80	0.80/0.07	0.93/0.12	1.09	1.10	B	C	F	F
	Purchase SWB	19	35	63	70	0.79/0.80	0.93/0.25	1.09	1.10	C	D	F	F
	Summer SEB	35	37	NA	NA	0.80	0.93	NA	NA	D	D	NA	NA
	Surface Artery NEB	5	4	NA	NA	0.33	0.42	NA	NA	B	A	NA	NA
21 Atlantic/Summer	Summer SEB	19	29	14	13	0.72/0.41	0.97/0.40	0.22/0.44	0.02/0.57	C	D	B	B
	Summer NWB	24	39	20	21	0.66/0.72	0.97/0.78	0.67/0.16	0.73/0.20	C	D	C	C
	Atlantic NB	17	42	20	24	0.00/0.72	0.03/0.97	0.73	0.74	C	E	B	C
22 Essex/Surface Artery	Essex EB	>100	>100	>100	>100	1.37/0.00	0.29/2.38	1.42	1.52	F	F	F	F
	Essex WB	>100	>100	>100	>100	1.37/0.70/0.99	0.03/1.52/2.33	1.42	1.52	F	F	F	F
	Lincoln NB	19	>100	>100	>100	0.62/0.36	0.65/1.63	1.42	1.52	C	F	F	F
	Surface Artery SB	>100	>100	>100	>100	0.01/1.37	0.55/2.38	1.42	1.52	F	F	F	F
23 Kneeland/Surface Artery	Kneeland EB	10	22	25	38	0.77	0.90	0.81	0.94	B	C	C	D
	Kneeland WB	22	52	17	49	0.90/0.51	1.12/0.59	0.60/0.61	1.03/0.77	C	E	C	E
	Surface Artery SB	12	19	24	43	0.77	0.90	0.82/0.64/0.68	0.78/0.77/1.10	B	C	C	E
24 Kneeland/Atlantic	Kneeland EB	34	27	36	22	0.99	0.73	0.65	0.39	D	D	D	C
	Atlantic NB	25	10	5	9	0.73/0.99	0.61/0.73	0.65	0.39	D	B	A	B

Table 3.13 (Cont.)

PROJECTED TRAFFIC OPERATIONS AT SIGNALIZED INTERSECTIONS

Location	Approach	Approach Delay (sec/veh) Future Baseline AM	Future Baseline PM	Proposed Action AM	Proposed Action PM	Volume-to-Capacity Ratio Future Baseline AM	Future Baseline PM	Proposed Action AM	Proposed Action PM	Level of Service Future Baseline AM	Future Baseline PM	Proposed Action AM	Proposed Action PM
25 Kneeland/Lincoln	**Kneeland EB**	**19**	**34**	**32**	**12**	**0.59**	**0.76**	**1.01/0.84**	**0.47/0.80**	**C**	**D**	**D**	**B**
26 Albany/Herald/ W. Broadway	**Herald EB**	**>100**	**>100**	**25**	**23**	**1.96**	**2.08**	**0.82**	**0.78**	**F**	**F**	**C**	**C**
	Albany SB	**9**	**85**	**18**	**17**	**0.85/0.56/0.13**	**1.18/0.33/0.14**	**0.82**	**0.78**	**B**	**F**	**C**	**C**
	W. Broadway	**17**	**>100**	**NA**	**NA**	**0.85**	**1.18**	**NA**	**NA**	**C**	**F**	**NA**	**NA**
27 Marginal/Albany	**WB**	**–**	**–**	**>100**	**13**	**–**	**–**	**0.27/1.47**	**0.42/1.04**	**–**	**–**	**F**	**B**
	NB	**–**	**–**	**>100**	**59**	**–**	**–**	**1.47**	**1.04**	**–**	**–**	**F**	**B**
	SB	**–**	**–**	**>100**	**37**	**–**	**–**	**1.47**	**1.04**	**–**	**–**	**F**	**D**
South Boston													
28 Dorchester/ W. Broadway	W. Broadway SEB	41	11	12	9	1.24/0.47/0.03	0.57/0.85/0.26	0.53/0.68	0.42/0.65	E	B	B	B
	W. Broadway NWB	27	18	40	24	0.93	0.80	0.49/0.95	0.08/0.76	D	C	E	C
	Dorchester NB	60	18	30	12	1.13/0.52	0.84/0.03	0.85/0.39	0.23/0.01	F	C	D	B
	Dorchester SB	>100	28	54	27	1.13	0.85	0.898	0.20	F	D	E	D
29 Andrew Square	Southampton SEB	>100	64	47	47	1.20/0.02	1.06/0.21	0.43	0.18	F	F	E	E
	Preble WB	25	23	84	75	0.66	0.40/0.26	1.00	0.95	C	C	F	F
	Dorchester Ave WB	>100	48	71	30	1.24	1.00	1.00	0.67	F	E	F	D
	Dorchester Ave SB	33	64	52	60	0.89	1.06	0.90	0.96	D	F	E	E
	Boston NEB	>100	>100	45	59	2.65/1.15	1.20	0.91	0.91	F	F	E	E
	Dorchester St SWB	>100	90	57	40	1.92/0.86	1.10	0.98	0.44	F	F	E	E
30 Dorchester/Old Colony	Dorchester Ave EB	>100	>100	49	51	2.18	3.30	0.49	0.88	F	F	E	E
	Dorchester Ave WB	>100	>100	51	57	1.27	1.73	0.71/0.15	0.88/0.50	F	F	E	E
	Old Colony NB	>100	9	35	59	1.27	0.60	1.02	0.17/1.03	F	B	D	E
	Old Colony SB	7	>100	41	19	0.58	1.73	0.26/0.93	0.94	B	F	E	C
31 East Broadway/I	East Broadway EB	14	12	15	14	0.58	0.68	0.37	0.64	B	B	B	B
	East Broadway WB	20	10	24	11	0.85	0.43	0.85	0.37	C	B	C	B
	I NB	11	8	15	11	0.85	0.68	0.85	0.64	B	B	C	B
	I SB	3	4	4	9	0.06	0.03	0.10	0.50	A	A	A	B
32 East First/Summer/L	East First EB	10	12	9	17	0.38	0.32	0.16	0.41	B	B	B	C
	East First WB	14	12	11	29	0.07/0.74	0.14/0.27	0.05/0.52	0.14/0.84	B	B	B	D
	L NB	8	13	9	3	0.74	0.95/0.52	0.52	0.35	B	B	B	A
	Summer SB	5	29	7	8	0.22	1.02	0.34/0.30	0.48/0.84	B	D	B	B
33 Congress/East Service	Congress SEB	NA	NA	57	35	NA	NA	0.79	0.55	NA	NA	E	D
	I-90 EB Exit NEB	NA	NA	11	11	NA	NA	0.79	0.55	NA	NA	B	B
	Haul Exit NWB	NA	NA	38	12	NA	NA	0.79	NA	NA	NA	D	B
34 Northern/East Service	Northern SEB	NA	NA	15	6	NA	NA	0.55	0.34	NA	NA	B	B
	Northern NWB	NA	NA	19	8	NA	NA	0.78	0.66	NA	NA	C	B
	East Service NEB	NA	NA	17	16	NA	NA	0.78/0.54/0.55	0.66/0.64/0.45	NA	NA	C	C
	East Service NWB	NA	NA	12	16	NA	NA	0.26/0.07	NA	NA	NA	B	C
35 D/Summer	Summer SEB	6	9	4	3	0.34/0.28	0.78/0.38	0.30	0.39	B	B	A	A
	Summer NWB	15	10	7	3	0.79	0.47	0.46	0.19	C	B	B	A
	D NEB	23	23	13	17	0.79	0.78	0.46	0.39	C	C	B	C

Table 3.13 (Cont.)

PROJECTED TRAFFIC OPERATIONS AT SIGNALIZED INTERSECTIONS

Location	Approach	Approach Delay (sec/veh) Future Baseline AM	Future Baseline PM	Proposed Action AM	Proposed Action PM	Volume-to-Capacity Ratio Future Baseline AM	Future Baseline PM	Proposed Action AM	Proposed Action PM	Level of Service Future Baseline AM	Future Baseline PM	Proposed Action AM	Proposed Action PM
East Boston													
36 Harborside/Porter	Harborside NEB	5	8	20	13	0.44	0.74	0.22	0.47	B	B	C	B
	Harborside SWB	5	7	21	17	0.40/0.29	0.73	0.33	0.72	A	B	C	C
	Driveway NWB	10	14	8	17	0.44	0.75	0.33	0.44	B	B	B	C
	Porter SEB	9	13	7	21	0.29/0.20	0.62/0.08	0.14	0.71	B	B	B	C
37 Central Square	Saratoga EB	12	16	17	22	0.29	0.12/0.65	0.14	0.26/0.22	B	C	C	C
	Saratoga WB	14	16	36	36	0.17/0.57	0.65	0.85	0.77	B	C	D	D
	Meridian NB	11	13	10	10	0.37	0.65	0.44	0.77	B	B	B	B
	Meridian SB	13	11	21	7	0.57	0.52	0.85	0.66	B	B	C	B
38 Chelsea/Visconti	Visconti NWB	48	26	22	17	1.00	0.70	0.689/0.104	0.22	E	D	C	C
	Chelsea NEB	7	8	6	6	0.50/0.02	0.40	0.04/0.26	0.33	B	B	B	B
	Chelsea SWB	13	11	21	23	0.72	0.70	0.712	0.78	B	B	C	C
39 Bennington/Neptune	Bennington NEB	47	75	29	29	0.94	1.07	0.736/0.567	0.65/0.40	E	F	D	D
	Bennington SWB	32	64	30	27	0.94		0.806/0.917	0.80/0.58	D	F	D	D
	Neptune NWB	51	71	20	29	0.94	0.15/1.07	0.579/0.341	0.49/0.995	E	F	C	D
	Neptune SEB	29	60	39	17	0.38/0.24	1.07/0.63	0.71/0.956	0.07/0.58	D	E	D	C
New Roadways													
40 Service Road #3/ THT Ramps	Service Road EB	NA	NA	1	3	NA	NA	0.05	0.44	NA	NA	A	A
	Service Road WB	NA	NA	7	3	NA	NA	0.28/0.56	0.53	NA	NA	B	A
	THT Ramp NB	NA	NA	12	14E	NA	NA	0.53/0.56	0.20/0.53	NA	NA	B	B
41 Service Road #1/ Harborside Service Road #3	Service Road #3 EB	NA	NA	2	8	NA	NA	0.22	0.22	NA	NA	A	B
	Service Road #3 WB	NA	NA	3	7	NA	NA	0.67/0.22	0.50	NA	NA	A	B
	SR-1 Ramp NB	NA	NA	20	9	NA	NA	0.68	0.50	NA	NA	C	B
	SB	NA	NA	16	7	NA	NA	0.24	.11	NA	NA	C	B
42 Service Road #3/ Ramp S-A/D	Ramp S-AD EB	NA	NA	12	3	NA	NA	0.30/0.38	0.51	NA	NA	B	A
	Service Road #3 NB	NA	NA	3	13	NA	NA	0.24	0.48	NA	NA	A	B
	Taxi Ramp SB	NA	NA	2	5	NA	NA	0.38/0.35	0.51/0.27	NA	NA	A	A
43 S. Boston Bypass Rd/ A Street Connector	Bypass Rd NB	--	--	8	11	--	--	0.75	0.76	--	--	B	B
	Bypass Rd SB	--	--	4	8	--	--	0.37	0.70	--	--	A	B
	A St Connector EB	--	--	12	21	--	--	0.46	0.78	--	--	B	C
44 S. Boston Bypass Rd/ Frontage Rd SB	Bypass Rd WB	--	--	15	16	--	--	0.14	0.35	--	--	C	C
	Frontage Rd SB	--	--	5	6	--	--	0.70	0.77	--	--	A	B
45 S. Boston Bypass Rd/ Frontage Rd NB	Bypass Rd EB	--	--	13	13	--	--	0.30/0.30	0.31	-	--	B	B
	Bypass Rd WB	--	--	13	13	--	--	0.07	0.34	--	--	B	B
	Frontage Rd NB	--	--	5	5	--	--	0.75	0.68	--	--	B	A

Source: Bechtel/Parsons Brinckerhoff

Traffic conditions on local streets would be substantially worse in the 2010 baseline condition.

3.2.4(b) Traffic Operations By Subarea

Descriptions of traffic operational characteristics for the Proposed Action and future baseline cases are provided below for each of the following subareas:

- o Area North of Causeway Street
- o Central Area (Causeway Street to the vicinity of Kneeland Street)
- o I-93/I-90 Interchange and Massachusetts Avenue Interchange Area
- o South Boston
- o East Boston

Area North Of Causeway Street. In this subarea, the Proposed Action will provide five through travel lanes in each direction over the Charles River bridge, in addition to ramps that will connect Route 1 and Leverett Circle, eliminating the need to use I-93 for movement between these two highways. Other ramps will furnish access from local streets to I-93, eliminating the short weaving sections that now disrupt traffic flow on the I-93 mainline. Moderate LOS D/E is expected on these sections of I-93.

In the 2010 baseline, the existing severe bottleneck on the northbound Charles River bridge would become much worse. In the southbound direction, five lanes from I-93 and Route 1 combined would neck-down to three lanes on the bridge. Long approach queues and delays would result in both directions during both daily peak periods.

North of the Charles River bridge on I-93, daily traffic volumes will increase by 28 percent northbound and 42 percent southbound, as a result of the Proposed Action. Peak hour traffic volumes on I-93 also will be substantially higher with the Proposed Action in place. In the northbound direction, the result will be a reduction in LOS from B to C in the AM peak hour, and C to E in the PM peak hour, as volumes carried during these time periods increase by 50 percent relative to the 2010 baseline condition. In the southbound direction, traffic operations will improve somewhat in both AM and PM peak hours as a result of the Proposed Action, despite a 40 percent increase in traffic volume. In the PM peak hour, LOS will improve from F in the 2010 baseline condition to D under the Proposed Action.

On the Tobin Bridge, northbound traffic will operate at LOS D and E in the AM and PM peak hours, respectively, under both the Proposed Action and the 2010 baseline. In the southbound direction, the Proposed Action will cause traffic conditions to improve from LOS E to D in the AM peak hour, and E to C in the PM peak hour, although the volume of traffic carried will increase. Alleviation of the southbound bottleneck approaching the Charles River bridge, downstream of the Tobin Bridge, will account for this improvement in traffic operations.

Traffic conditions at the three key intersections in the Area North of Causeway Street are discussed below:

- o Leverett Circle, the intersection of Charles and Nashua Streets, and the O'Brien Highway: This intersection will operate at LOS B to E with the Proposed Action in place, which represents a major improvement over the 2010 baseline condition

(breakdown LOS F). Operations with the Proposed Action also will be substantially better than existing conditions.

The dramatic improvement in travel conditions can be traced directly to three geometric modifications. First, the eastbound Storrow Drive approach to the Circle will be removed and shifted to an underpass beneath the intersection connecting to the I-93 access ramps. Second, mainline and ramp modifications on I-93 will eliminate the merge and bottlenecks that currently cause intermittent queuing on the connector ramps and thus restrict flow leaving the Circle. Third, traffic movements from Nashua Street to the I-93 ramps will take place on a new connector upstream of the intersection, minimizing the need for vehicular storage between the northeastbound and southwestbound approaches.

o City Square, the intersection of Chelsea Street, North Washington Street (the Charlestown bridge), and Rutherford Avenue: With the Proposed Action in place, this intersection will show marginal improvement on all approaches compared to the future baseline, where all approaches would operate at LOS F (delays exceeding 100 SPV). In the Proposed Action condition, the intersection will operate in the LOS D-F range.

o Charles River dam/Commercial Street/Gilmore Bridge/O'Brien Highway: The Proposed Action will not have a significant impact on this intersection.

Central Area. In this subarea, the Proposed Action comprises a new I-93 tunnel within downtown Boston, as well as strategic surface service roads (Atlantic Avenue and Surface Artery) carrying vehicular traffic to and from the mainline.

Traffic volumes on the Central Artery will increase for the Proposed Action as the improved highway alignment will have an expanded carrying capacity to accommodate greater vehicular demands. Traffic operations along the mainline will improve substantially from the widespread breakdown conditions experienced currently and forecast in the future baseline case. The inbound bottleneck locations approaching downtown from north and south will be reconstructed under the Proposed Action to accommodate a significantly higher traffic volume, thereby diverting traffic from parallel surface arterials such as the Charlestown bridge. Despite the fact that more traffic will use the Central Artery in the Proposed Action case, peak period flow will be relatively uncongested. In the morning, delays will be limited to the southbound segment upstream of the merge between the Leverett Circle on-ramp and the mainline, and weaving congestion on and approaching the southbound segment between the New Chardon Street entrance and the Oliver Street exit. In the PM peak hour, the Central Artery generally will operate at speeds in the 30 to 40 mph range, except for the southbound eastern barrel immediately upstream of the merge with the western barrel.

Some peak period entrance ramp congestion in the Central Area is expected under the Proposed Action. Specifically, the northbound ramps from the Massachusetts Turnpike/Frontage Road and from Essex Street/Northern Avenue will operate at LOS F during both the morning and afternoon peak periods and the southbound ramps from Congress Street will operate at LOS F during the afternoon peak period. Since these ramps will enter the mainline as added lanes, merging maneuvers will not be required, and ramp congestion is not anticipated to significantly affect mainline flow.

Major existing deficiencies on the Central Artery would cause increased congestion in the 2010 baseline condition. Severe congestion would occur in the 2010 baseline at the northbound Central Artery merge with the entrance ramp from Leverett Circle. The high-entrance volumes would require two travel lanes, disrupting flow in the left lane of the already constricted Artery. A heavy demand on the now lightly used Haymarket southbound off-ramp also would result in weaving congestion and speed reductions for exiting motorists as well as those entering from Leverett Circle. Downstream, congestion would be expected approaching the Beach Street exit ramp as a high volume of traffic entering the Artery from Congress Street would attempt to merge into the through traffic stream while only a relatively low volume would exit at Beach Street. During the afternoon peak period, constrictions to outbound traffic at each end of downtown, i.e., the merge with the Leverett Circle entrance northbound, and the merge with the Congress Street entrance southbound, would result in the deterioration of traffic operations relative to today, with longer queues and increased delays.

As a part of the Proposed Action, continuous roadways will be created in this area between Kneeland Street and North Washington Street northbound, and Causeway Street to Kneeland Street southbound. Improved operations on the reconstructed surface streets will result. Surface street traffic operations in this subarea are discussed below for the north-south surface roads paralleling the Central Artery, and at Keany Square, on the northern edge of the Central Area.

- o Atlantic Avenue: Atlantic Avenue will carry lower volumes with the Proposed Action in place, relative to the 2010 baseline, because vehicles will shift onto the new Central Artery. From Northern Avenue south, traffic operations will improve substantially, with most intersections operating at LOS B to D, as compared to LOS F in the 2010 baseline.

- o Surface Artery Corridor: In the 2010 baseline case, Surface Artery/Purchase Street would continue to provide for two to three travel lanes in each direction, with its major intersections controlled by traffic signals. In the northbound direction, the Surface Artery would terminate at the Callahan Tunnel, as it does today, whereas the new northbound surface roadway in the Proposed Action will terminate at North Washington Street. In the case of the Proposed Action, a new southbound arterial street will begin in the vicinity of Causeway Street, as compared to its current northerly end point at North Street, providing a virtually continuous frontage road.

  The surface roadways replacing the existing Surface Artery will function as two separate one-way streets. The separation between the streets will allow left-turning vehicles, particularly at key intersecting streets such as State and High Streets, to better stay out of the main traffic stream between the north- and southbound roadways, minimizing their impact on through traffic. (Daily traffic volumes on the Surface Artery corridor in the 2010 baseline and Proposed Action conditions as shown in Figures 3.20 and 3.21.)

  In the AM peak period with the Proposed Action in place, only two of the total 10 intersections on the southbound surface roadway will operate at LOS F -- Purchase/Summer Streets and Essex Street/Surface Artery. The remaining eight locations will operate at LOS C to E. In the PM peak hour, three of ten

intersections will operate at LOS F: Congress/Purchase Streets; Purchase/Summer Streets; and Essex Street/Surface Artery. The remaining seven locations will operate in the LOS C to D range.

Under the 2010 baseline case, five of seven intersections along the Surface Artery/Purchase Street corridor would operate with at least one approach at LOS F in the AM peak hour. In the PM peak hour, three of seven intersections along the corridor would operate with one or more approaches at LOS F. Overall, the 2010 baseline case would represent a serious deterioration from existing LOS, which range from E up to C.

- Keany Square: Under the Proposed Action condition, significant capacity increases on I-93 across the Charles River and for trans-harbor crossings will reduce the traffic flow over the Charlestown bridge and other similar local bridge crossings. Traffic operations, therefore, are anticipated to improve at these crossings. In the 2010 baseline condition, traffic volume increases at Keany Square would worsen peak period congestion, causing spillover into the adjacent off-peak hours.

I-93/I-90 Interchange And Massachusetts Avenue Interchange Area. The Proposed Action will expand mainline highway capacity in this area, alleviating existing constraints north of Southampton Street. In the absence of the Proposed Action, traffic operations would worsen in both the north and southbound directions, relative to present day conditions, due to general traffic growth. The Proposed Action will eliminate the existing southbound capacity constriction at the Massachusetts Avenue on-ramp. In the 2010 baseline condition, this bottleneck would result in LOS F traffic conditions extending throughout the upstream segments of the Southeast Expressway and the entire Central Artery, beyond the Charles River bridge.

With the Proposed Action in place, there will be no capacity constriction at the Massachusetts Avenue interchange, but southbound merging congestion and LOS F operations are expected at the Southampton Street entrance ramp during both peak periods. This congestion is attributable in the afternoon peak hours to a high entering volume from Southampton Street merging with four moderately filled lanes of mainline traffic. In the PM peak hour, congested operations will extend upstream from Southampton Street as far as the Dewey Square tunnel, which represents a marked improvement compared to the 2010 baseline condition, as described above. The I-93 lane arrangement south of Massachusetts Avenue will be four general purpose lanes in the peak direction, with a possible contraflow HOV lane. (The contraflow lane is under study by the Department as a separate project.) If the contraflow lane project is implemented, there would be three lanes in the off-peak direction. Although southbound traffic volumes in the morning peak hour will be significantly lower than in the PM peak, the availability of only three lanes at this time, if the contraflow lane is implemented, would result in some congested operations.

In the northbound direction, traffic operations within the project limits will improve as a result of the Proposed Action, with LOS increasing from F in the 2010 baseline case to the D-E range with the Proposed Action in place. Speeds will increase from 11 and 12 mph in the 2010 baseline to the 32 to 38 mph range under the Proposed Action in the AM peak hour, and 31 to 45 mph in the PM peak hour.

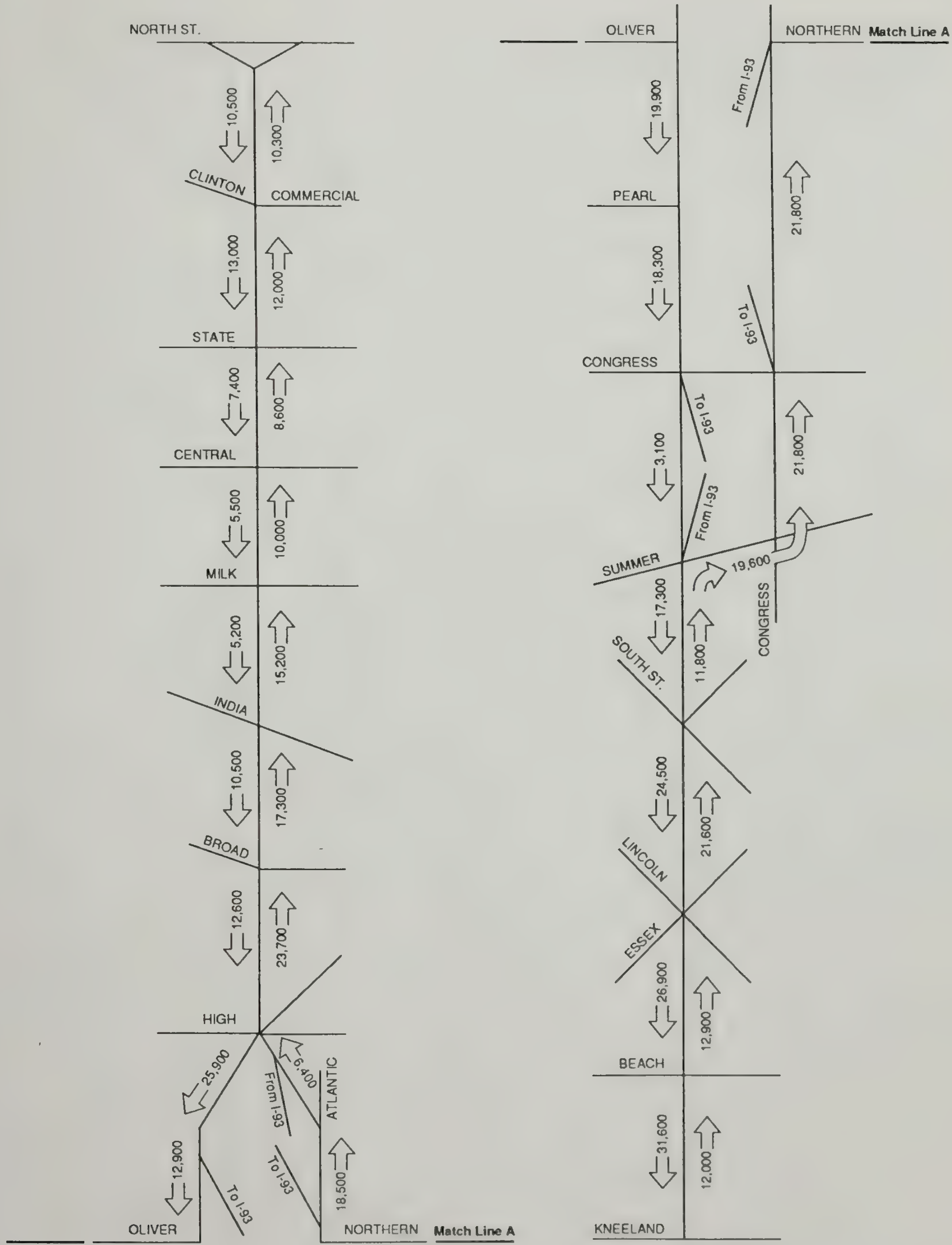

FIGURE 3.20

2010 Future Baseline - Surface Artery AWDT Volumes

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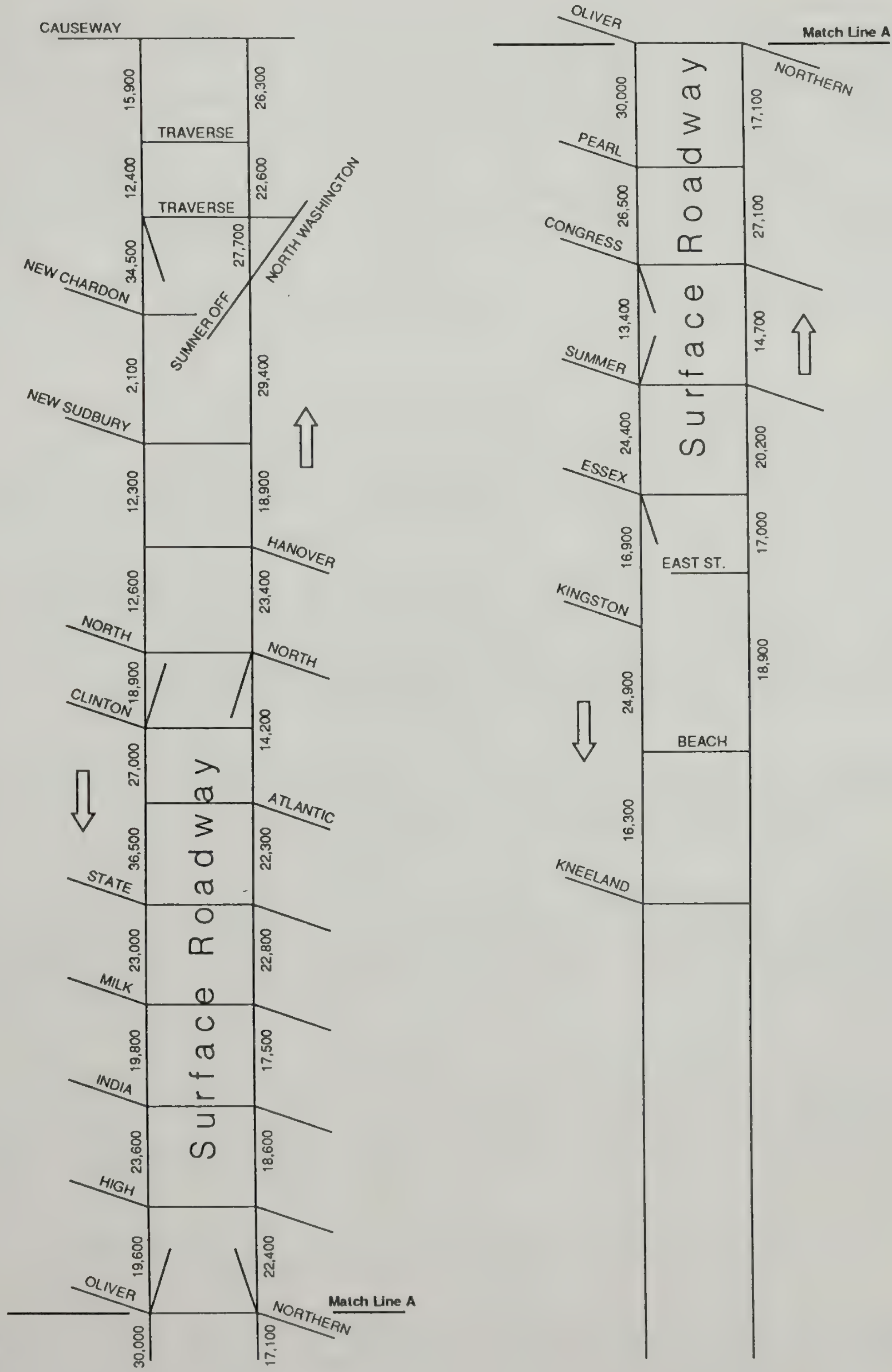

FIGURE 3.21

2010 Proposed Action - Surface Roadway AWDT Volumes

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CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

South Boston. Three major improvements incorporated in the Proposed Action will serve to divert motorists away from local streets in South Boston: expansion of I-93 capacity north of Southampton Street; the extension of I-90 with an interchange at Congress Street in South Boston; and construction of the South Boston Bypass Road to serve trucks and HOVs. While existing bottleneck points such as Andrew Square, Neponset Circle, and the Fort Point Channel bridges will likely continue to serve high traffic volumes entering into the area, traffic volumes will be reduced relative to the 2010 baseline condition. Significant travel congestion generally will be confined to the morning inbound peak periods for the Proposed Action condition -- a considerable improvement over the dual peak period congestion widespread in the future baseline case, and, to a lesser extent, even in the present day. A summary of conditions is presented below for strategic intersections on arterial roadways and the newly created I-90 service roads.

- Andrew Square, the intersection of Southampton Street, Dorchester Avenue, and Boston, Dorchester and Preble Streets: Under both the 2010 baseline and Proposed Action conditions, the intersection will operate at LOS F in the AM peak. The Artery/Tunnel Project will cause evening peak period operations to improve, however, relative to the baseline condition, with some critical approaches at LOS D and E.

  Specifically, the intersection will benefit from a reduction in traffic volumes as fewer vehicles will filter through this point seeking a travel alternative to the expressway. In the 2010 baseline condition, Andrew Square would operate at breakdown LOS F on most approaches in the PM as well as the AM peak hour. Delays would be lengthy, exceeding 100 SPV in both the AM and PM.

- Old Colony Avenue/Dorchester Street: The intersection will improve significantly due to the Proposed Action -- to slightly under-capacity level E (for the total intersection) from an overall breakdown LOS F in the 2010 baseline condition.

- East Service Road intersections with Congress Street and Northern Avenue: These two new intersections created by the Proposed Action will process traffic between the South Boston industrial area and the I-90 extension to the Third Harbor Tunnel. Both locations will generally operate acceptably, with overall levels of traffic operations within the B to C range.

- Dorchester Avenue/West Broadway: Under the Proposed Action, this intersection will operate at LOS D during the morning peak period, and LOS B to D in the afternoon peak. Under the future baseline condition, two approaches would operate at LOS F with long delays during the AM peak period.

- East First/Summer/L Streets: This intersection will operate at an overall LOS B under both the Proposed Action and the 2010 baseline.

- D/Summer Streets: Under the Proposed Action, peak period operations will improve overall to LOS A and B, compared to LOS B to C operations in the future baseline during both peak periods.

- Albany Street/Broadway/Herald Street: Under the Proposed Action, peak period level of service will improve to LOS C. In the future baseline condition, this critical intersection would operate with long delays at LOS F.

East Boston/Logan Airport. In the Proposed Action case, the vehicular traffic pattern between downtown Boston and East Boston/Logan Airport/ Route 1A will be significantly changed. From points south and west, movements destined to East Boston and the airport will be completed through the Third Harbor Tunnel, while from points north most travellers will continue to use the Callahan/Sumner Tunnel crossings. Trips oriented to/from downtown Boston will have the option of using either the existing tunnels or the new Third Harbor Tunnel, although from many parts of downtown Boston the new Harbor crossing will be more convenient than the existing Callahan/Sumner Tunnels.

Sumner/Callahan Tunnel daily traffic will decrease by 28 percent due to relief from the added cross-harbor capacity in the Third Harbor Tunnel, compared to the 2010 baseline condition. The combination of reduced tunnel traffic volumes and improved traffic flow on the Central Artery will result in a major upgrading of traffic operations in the Sumner Tunnel.

In the 2010 baseline condition, the increase in congestion in the Sumner/Callahan Tunnels would force more drivers to divert to bypass routes through the airport internal service roads to reach access points at Neptune Road and Maverick Street. Because of projected backups on the mainline highway, more southbound Route 1A traffic would use the Curtis Street exit to shift to local East Boston streets, such as Bennington and Saratoga Streets.

Airport inbound traffic would continue to be concentrated on the Route 1A access ramps in the 2010 baseline condition. This would overload the ramp system and create unacceptable conditions (LOS F) on the airport on-site inbound roadway. In the airport outbound direction, similar problems would occur and the airport-to-Sumner Tunnel ramp would be closed for longer periods of time in the AM and PM peak periods relative to existing conditions, due to queues extending from the tunnel toll plaza.

In the Proposed Action case, the westbound Third Harbor Tunnel will operate at LOS E in both the AM and PM peak hours, with travel speeds of about 30 and 35 mph, respectively. The westbound approach to the tunnel, which includes a merge between the airport on-ramp and I-90 mainline, will operate at LOS F in the PM peak. Capacity on the airport on-ramp and I-90 mainline will be adequate to accommodate the entire 2010 peak hour storage demand. Traffic flow metering at the mainline Third Harbor Tunnel toll booth can be used to prevent backups onto the airport egress road, with a comfortable margin of safety for incidents and peak holiday periods. In the eastbound direction, LOS E conditions will be experienced in the Third Harbor Tunnel during the PM peak period as end-of-day airport activities will coincide with commuter patterns.

Conditions on Route 1A north of the airport will improve with the Proposed Action in place, relative to the 2010 baseline condition. Route 1A will continue to experience some significant travel congestion under the Proposed Action condition, although the presence of an alternative tunnel route from South Boston will lessen the traffic demand to and from its connections to the Sumner/Callahan Tunnels. While the roadway will operate with congested traffic conditions south of the airport ramps under the Proposed Action, conditions will improve relative to the 2010 baseline condition. Southbound travel speeds toward the Sumner Tunnel toll booths will range from a low of 16 mph during the PM peak period to a high of 28 mph in the AM peak period. In the northbound direction, this section of Route 1A traffic will operate at about 45 mph in both the AM and PM peak periods. The area bounded by the

I-90 connections to Route 1A and the Neptune Road ramp will operate at LOS E to F, accompanied by speeds of between 23 and 36 mph, which represents an improvement over operations in the 2010 baseline condition, when low speeds of between 9 and 18 mph would be experienced in the southbound direction.

The local street network will show a significant improvement in overall travel operations under the Proposed Action, because vehicles will tend to remain on the area's limited-access facilities, due to both added capacity and active traffic control measures. In general, the local streets will operate with an acceptable level of traffic flow.

The geometry of the Proposed Action does not provide an airport exit to Neptune Road, which will eliminate a major source of traffic from the critical Neptune Road/Bennington Street intersection. The airport-to-Route 1A northbound on-ramp is designed in the Proposed Action to merge with the mainline after the Neptune Road off-ramp, which will remove airport-exiting vehicles from the northbound weave, and at the same time prevent them from diverting to local streets in the Neptune Road area of East Boston. Peak period levels of service at this intersection would be in the E to F range in the future baseline, but will improve to LOS D with the Proposed Action in place, as a result of reduced traffic volume.

3.2.5 Other Projected Vehicular Traffic Characteristics

3.2.5(a) Hours Of Congestion

A key indicator of the relative quality of traffic operating conditions in the context of an urban transportation system is the duration of congestion throughout the day. There are eight locations on the study area highway network where congestion currently occurs each weekday. The duration of congestion ranges from 4 hours per day at the Callahan Tunnel and the southbound Southeast Expressway, to 9 hours per day at the Central Artery portal of the Sumner Tunnel. Figure 3.22 presents a comparison of the hours of congestion for 1987, the 2010 baseline condition, and the 2010 Proposed Action. Speeds will increase over the 2010 baseline from under 20 mph generally (and as low as 7 mph) to the 30 to 40 mph range, even in the busiest hour.

In the 2010 baseline condition, traffic congestion would increase substantially compared to existing conditions. On the I-93 southbound approach to the Charles River bridge, congested operations would increase from 6 hours under existing conditions to 14 hours under the 2010 baseline. The Route 1 southbound approach to the bridge would also operate with 14 hours of congestion in the 2010 baseline, compared to 8 hours of congestion today. Traffic operations in the Callahan and Sumner Tunnels would be congested for 9 and 10 hours per day, respectively.

With the Proposed Action in place, the duration of congestion will diminish markedly in the study area highway network. At both the I-93 and Route 1 southbound approaches to the Charles River bridge, congestion will decrease from 14 hours in the 2010 baseline to only 1 hour under the Proposed Action. In the Callahan and Sumner Tunnels, congested operations will occur for 2 hours and 1 hour, respectively, with the Proposed Action in place, as compared to 9 and 10 hours in the 2010 baseline condition. At all of these locations, the duration of congestion will actually decrease substantially under the Proposed Action, compared to existing conditions.

There is only one location where the Proposed Action will cause an increase in congestion. On I-93 northbound, north of the Charles River and Gilmore bridges, a single hour of congestion will be experienced under the Proposed Action, whereas there would be no significant congestion under the 2010 baseline. Under the 2010 baseline condition, as today, the severe operational bottleneck at the northbound approach to the Charles River bridge would meter traffic flow, preventing segments of I-93 north of the bridge from reaching their operational capacities. With the Proposed Action in place, the bottleneck south of the Charles River bridge will be alleviated, and more traffic will be able to reach I-93 north of the bridge in peak hours, resulting in 1 hour of congested operations.

The overall reduction in traffic congestion associated with the Proposed Action will be a direct result of expanded highway capacity. Existing operational bottlenecks on the Central Artery will be alleviated; cross-harbor capacity will be increased; and the I-93/Massachusetts interchange will be modified to improve traffic flow on the Southeast Expressway. Hours of congestion on new segments of I-90 also are noted in the Figure 3.21. Congested traffic operations will be in effect for 0 to 4 hours at the five locations shown, with the maximum congestion point on the Seaport Access Road westbound, at the on-ramp from the Massport Haul Road, before the South Boston interchange.

3.2.5(b) Vehicle Miles Of Travel And Vehicles Hours Of Travel

VMT is a measure of the cumulative distance travelled by all vehicles on a study area roadway system. Thus, changes in VMT reflect an increase (or decrease) in the total amount of vehicular travel expected as the result of a major highway improvement. VHT is a measure of the cumulative time travelled by all the vehicles on a study area roadway system, i.e., the time expended during the accumulation of VMT. To calculate changes in VHT, the aggregate hours of travel of all the vehicles on the future "build" network (including those vehicles induced or added to the network due to its improved characteristics) are compared with the aggregate hours of travel of all the vehicles on the future baseline network.

VMT and VHT are compared in Table 3.14 for the Proposed Action, the 2010 baseline and existing conditions. With the Proposed Action in place, study area VMT will increase by 3 percent or 158,800 per day and 52.6 million per year, relative to the 2010 baseline. The increase in VMT represents a diversion of travel onto mainline highways in the study area from other roadways outside the study area, rather than an increase in the number of trips.

In terms of VHT, the Proposed Action will cause the total number of hours of vehicle operation to decrease by 141,317 per day and 46.8 million per year in the study area, which represents a 29 percent reduction. These two findings (VMT increases slightly, while VHT decreases substantially) show that a small percentage of individual motorists will change their routes in order to minimize travel time, using the new highway segments, even though this means they will have to drive longer distances to do so. In addition, a relatively small number of motorists will revise their travel destinations to take advantage of the fact they can now reach additional employment, retailing, or other opportunities in the same or less driving time, even though this means driving further distances. The better safety record and driver comfort associated with well designed interstate highway segments relative to local streets and surface arterials also will be factors influencing some drivers to go out of their way and drive further in order to use such facilities for at least a portion of their trip. The estimated VHT reduction will result from increased travel speeds made possible because of the added roadway capacity and resulting improved levels of traffic service associated with the Proposed Action.

LEGEND				
Location	○ 1987 Base	● 2010 Base	△ 2010 Proposed Action	Description
A	0	0	1	I-93 Northbound, past Gilmore Bridge
B	NA	NA	[illegible]	Connector over Charles to Storrow Westbound
C	6	14	1	I-93 Southbound, over Charles River
D	8	14	1	Route 1 Southbound at Charles River Bridge
E	5	11	4	Central Artery Northbound at Storrow Drive On-Ramp
F	5	11	1	I-93 Northbound, after Sumner On-Ramp
G	4	[illegible]	2	Callahan Tunnel, at Downtown Portal
H	9	10	1	Sumner Tunnel, at Downtown Portal
I	6	13	[illegible]	Southeast Expressway Northbound at E Berkeley Street On-Ramp
J	4	6	NA	Southeast Expressway Southbound at Mass Ave On-Ramp
K	NA	NA	0	Seaport Access Road Westbound before Congress Street Off Ramp
L	NA	NA	4	Seaport Access Road Eastbound before Third Harbor Tunnel Portal
M	NA	NA	NA	I-90 Southbound at Toll Plaza
N	0	5	3	Route 1A North Bound before Neptune Off Ramp
O	9	NA	4	Route 1A Southbound after Neptune On-Ramp
P	NA	NA	4	I-90 Westbound at Massport Haul Road On Ramp
Q	NA	NA	1	I-90 Eastbound at West Service Road On Ramp

NA -Location not applicable

FIGURE 3.22

Hours Of Congestion: 1987, 2010 Baseline And 2010 Proposed Action

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Table 3.14

COMPARISON OF EXISTING AND PROJECTED VMT AND VHT IN STUDY AREA

	1987/88	2010 Baseline	2010 Proposed Action
VMT			
Daily	3,880,660	5,120,000	5,278,800
Annual	1,284.5 million	1,694.7 million	1,747.3 million
VHT			
Daily	267,400	492,617	351,300
Annual	88.5 million	163.1 million	116.3 million

1. VMT = Vehicle Miles Travelled
2. VHT = Vehicle Hours Travelled

Source: Bechtel/Parsons Brinckerhoff

While the above discussion indicates that the Proposed Action will result in an overall increase in study area VMT, this increase is confined to the expressway system; the impact of the project on local streets and arterials is to lower VMT substantially. This result is consistent with the previously described impacts on daily and peak hour traffic volumes, where it was shown that traffic volumes on a large majority of analyzed roadway segments and intersections will decrease in response to the Proposed Action.

All communities, except for the I-93/I-90 Interchange subarea, will experience reduced VMT on local streets as a result of the Proposed Action. (Tables 3.15 through 3.18 present daily VMT and VHT for the 2010 baseline and Proposed Action by geographic subarea and type of roadway.) Throughout the study area as a whole, there will be a decrease of 495,075 VMT on local streets and arterials per day, or 18 percent, compared to the 2010 baseline condition. As discussed previously, VHT will decline throughout the study area for all roadway facilities as a result of the Proposed Action. This effect will be even more pronounced on local streets. The cumulative hours travelled on local streets will decrease by 34 percent with the Proposed Action, relative to the 2010 baseline condition.

3.2.5(c) Truck Movements And Inflammable Cargo Routes

It is projected that total truck volumes will increase substantially by the year 2010, under both the baseline and Proposed Action conditions. On a percentage basis, however, the volume of trucks relative to total traffic is expected to decrease in most parts of the study area. This is because land uses which are relatively low-intensity generators of truck trips, i.e., office and residential, are projected to account for most study area growth. The Proposed Action will not affect the volume of truck traffic throughout the study area as a whole or by major subarea, but will cause a shift in truck traffic from local streets and onto the expressway system. As a result, the volume of truck traffic on local streets generally will decline, relative to the 2010 baseline condition.

The expected increase in truck traffic is likely to be more pronounced in the highest-growth areas such as Charlestown Navy Yard, the South Boston industrial/commercial area, and Logan Airport. However, while overall growth of 476 percent and 99 percent, respectively, is expected in the Charlestown Navy Yard and South Boston areas, industrial activity is projected to grow only by 19 percent and 2 percent respectively. Hence, for these two areas, truck traffic is expected to increase at a slower rate than general traffic. At Logan Airport, however, the total occupied building increase is projected at 105 percent, while the industrial sector alone is anticipated to grow 144 percent. Hence, for this location, truck traffic will increase at a rate greater than that of general traffic.

Because of their added size and lower acceleration capabilities, trucks and other heavy vehicles tend to reduce operating speeds on grades and diminish the capacity of roadways, which tends also to reduce safety. These impacts generally are greater on surface streets and intersections than on controlled access facilities. Areas which are expected to benefit most from the Proposed Action include the South Boston and East Boston/Logan Airport areas.

South Boston. While the ratio of trucks to general traffic is projected to decrease by the year 2010, the absolute volumes of trucks will increase by an estimated 41 percent and trucks will continue to be a significant factor in traffic operations in the South Boston area. Currently, due to weight restrictions on a number of bridges linking the area to the regional highway network, heavy trucks in South Boston are forced to use congested local residential streets to reach the industrial area. This causes significant adverse

Table 3.15

DAILY VEHICLE MILES TRAVELLED (VMT) BY COMMUNITY AND FACILITY TYPE FOR 2010 BUILD CONDITIONS

Project Area	HOV	Expressway	Local Street	Ramp	Total
Area North Of Causeway Street					
Charlestown (except Navy Yard)	0	482,439.1	149,586.3	79,031.6	711,057.0
Charlestown Navy Yard	0	0	25,422.0	0	25,422.0
North Station	0	182,292.7	40,930.6	1,874.3	241,971.6
West End	0	48,077.3	37,788.2	12,573.9	98,439.4
Subtotal	0	712,809.1	253,727.1	110,353.8	1,076,890.0
Central Area					
Government Center	0	0	49,132.6	11,787.7	60,920.3
North End	0	128,329.1	42,048.0	26,259.5	196,636.6
Waterfront	0	142,037.3	34,359.3	17,536.8	193,933.4
Financial District	0	0	48,319.8	0	48,319.8
Midtown - Retail	0	0	60,240.7	0	60,240.7
Chinatown - Bay Village	0	52,147.7	26,586.7	1,185.2	79,919.6
South Station - Leather District	5,174.8	132,639.2	38,072.2	47,755.8	223,642.0
Beacon Hill	0	50,898.6	48,934.7	19,912.1	119,745.4
Subtotal	5,174.8	506,051.9	347,694.0	124,437.1	983,357.8
I-93/I-90 Interchange And I-93 Massachusetts Avenue Interchange Area					
South Bay/Newmarket	32,180.1	341,447.4	145,821.2	19,811.5	539,260.2
South End	10,651.7	146,451.8	196,728.8	26,531.5	380,363.8
Subtotal	42,831.8	487,899.2	342,550.0	46,343.0	919,624.0
South Boston And Bypass Road Area					
South Boston Industrial Area	10,412.8	212,002.9	115,397.0	46,693.7	384,506.4
South Boston Lower End	8,501.0	16,995.6	66,188.6	6,372.9	98,058.1
South Boston: City Point	0	0	195,822.3	0	195,822.3
Subtotal	18,913.8	228,998.5	377,407.9	53,066.6	678,386.8

Table 3.15 (Cont.)

DAILY VEHICLE MILES TRAVELLED (VMT) BY COMMUNITY AND FACILITY TYPE FOR 2010 BUILD CONDITIONS

Project Area	HOV	Expressway	Local Street	Ramp	Total
East Boston/Logan Airport Area					
East Boston - Jeffries Point	0	71,876.3	26,440.9	0	98,317.2
East Boston - Eagle Hill	0	32,243.4	88,945.8	1,972.4	123,161.6
East Boston - Logan Airport	244.3	185,403.5	30,166.0	35,576.0	251,389.8
East Boston - Orient Heights	0	79,203.5	72,477.6	88.0	151,769.1
Subtotal	244.3	368,726.7	218,030.3	37,636.4	624,637.7
Others					
Back Bay	0	107,559.5	104,351.5	24,021.1	235,932.1
Prudential - Copley	0	197,805.4	87,175.6	2,280.5	287,261.5
East Cambridge - East Somerville	0	0	472,724.2	0	472,724.2
Subtotal	0	305,364.9	664,251.3	26,301.6	995,917.8
Study Area Total	67,164.7	2,609,850.3	2,203,660.0	398,138.5	5,278,814.1

Source: Bechtel Parsons/Brinckerhoff

Table 3.16

DAILY VEHICLE MILES TRAVELLED (VMT) BY COMMUNITY AND FACILITY TYPE FOR 2010 NO-BUILD CONDITIONS

Project Area	HOV	Expressway	Local Street	Ramp	Total
Area North Of Causeway Street					
Charlestown (excluding Navy Yard)	0	376,585.2	182,715.2	79,756.0	639,056.4
Charlestown Navy Yard	0	35,776.8	28,809.7	0	64,586.5
North Station	0	61,332.1	52,493.6	47,646.1	161,471.8
West End	0	50,823.9	37,607.8	15,716.9	104,148.6
Subtotal	0	524,518.0	301,626.3	143,119.0	969,263.3
Central Area					
Government Center	0	34,576.3	48,013.2	7,082.8	89,672.3
North End	0	89,755.5	55,118.3	7,722.2	152,596.0
Waterfront	0	121,199.5	48,093.2	17,471.5	186,764.2
Financial District	0	0	54,634.8	2,237.9	56,872.7
Midtown - Retail	0	0	71,128.0	0	71,128.0
Chinatown - Bay Village	0	52,213.5	33,595.4	0	85,808.9
South Station	0	106,460.9	45,428.3	54,904.8	206,794.0
Beacon Hill	0	56,053.0	60,546.3	9,060.0	125,659.3
Subtotal	0	460,258.7	416,557.5	98,479.2	975,295.4
I-93/I-90 Interchange And I-93 Massachusetts Avenue Interchange Area					
South Bay/Newmarket	0	351,045.2	129,628.4	30,957.1	511,630.7
South End	0	138,905.6	222,969.1	4,813.3	366,688.0
Subtotal	0	489,950.8	352,597.5	35,770.4	87,818.7
South Boston					
South Boston Industrial Area	0	0	138,566.8	0	138,566.8
South Boston Lower End	0	0	88,680.5	0	88,680.5
South Boston: City Point	0	0	242,076.9	0	242,076.9
Subtotal	0	0	469,324.2	0	469,324.2

Table 3.16 (Cont.)

DAILY VEHICLE MILES TRAVELLED (VMT) BY COMMUNITY AND FACILITY TYPE FOR 2010 NO-BUILD CONDITIONS

Project Area	HOV	Expressway	Local Street	Ramp	Total
East Boston/Logan Airport Area					
East Boston-Jeffries Point	0	84,616.6	32,970.6	0	119,387.2
East Boston-Eagle Hill	0	335,498.0	135,839.1	2,542.3	171,929.4
East Boston-Logan Airport	0	51,819.0	142,872.4	23,613.6	218,305.0
East Boston-Orient Heights	0	118,971.3	68,869.5	78.1	187,918.9
Subtotal	0	290,754.9	380,551.6	26,234.0	697,540.5
Others					
Back Bay	0	111,121.1	126,801.7	20,906.5	258,829.3
Prudential - Copley	0	212,852.5	103,861.6	7,342.9	324,057.0
East Cambridge - East Somerville	0	0	547,414.2	0	547,414.2
Subtotal	0	323,973.6	778,077.5	28,249.4	1,130,300.5
Study Area Total	0	2,089,456.0	2,698,734.6	331,852.0	5,120,042.6

Source: Bechtel Parsons/Brinckerhoff

Table 3.17

DAILY VEHICLE HOURS TRAVELLED (VHT) BY COMMUNITY AND FACILITY TYPE FOR 2010 BUILD CONDITIONS

Project Area	HOV	Expressway	Local Street	Ramp	Total
Area North Of Causeway Street					
Charlestown (excluding Navy Yard)	0	16,647.1	11,271.5	34,24.7	31,343.3
Charlestown Navy Yard	0	0	1,519.9	0	1,519.9
North Station	0	5,452.8	3,718.5	839.1	10,010.4
West End	0	1,816.2	3,710.4	577.5	6,104.1
Subtotal	0	23,916.1	20,220.3	4,841.3	48,977.1
Central Area					
Government Center	0	0	6,355.3	557.0	6,912.3
North End	0	3,393.1	3,688.6	1,192.9	8,274.6
Waterfront	0	4,014.3	2,901.8	1,234	8,150.1
Financial District	0	0	10,157.1	0	10,157.1
Midtown - Retail	0	0	7,794.8	0	7,794.8
Chinatown - Bay Village	0	1,319.3	3,108.8	0	4,585.8
South Station	212.3	3,664.6	3,575.0	2,083.2	9,747.4
Beacon Hill	0	2,138.2	6,930.4	1,564.9	10,633.5
Subtotal	212.3	14,529.5	44,511.8	6,789.7	66,043.3
I-93/I-90 Interchange And I-93 Massachusetts Avenue Interchange Area					
South Bay/Newmarket	700.9	13,987.2	21,269.0	1,702.6	37,659.7
South End	221.9	3,880.0	18,954.7	889.1	23,945.7
Subtotal	922.8	17,867.2	40,223.7	2,591.7	61,605.4
South Boston and Bypass Road Area					
South Boston Industrial Area	0	0	60,371.8	0	60,371.8
South Boston Lower End	291.7	5,688.0	7,892.8	1,630.9	15,503.4
South Boston: City Point	300.2	447.7	5,713.7	143.7	6,605.3
Subtotal	591.2	6,135.7	73,978.3	1,774.6	82,480.5

Table 3.17 (Cont.)

DAILY VEHICLE HOURS TRAVELLED (VHT) BY COMMUNITY AND FACILITY TYPE FOR 2010 BUILD CONDITIONS

Project Area	HOV	Expressway	Local Street	Ramp	Total
East Boston/Logan Airport					
East Boston-Jeffries Point	0	0	31,312.0	0	31,212.9
East Boston-Eagle Hill	0	1,803.9	1,389.0	0	3,193.8
East Boston-Logan Airport	0	1,051.6	7,097.2	67.2	8,216.0
East Boston-Orient Heights	15.5	5,420.0	1,552.6	1,702.1	8,690.2
Subtotal	15.5	8,275.5	41,352.6	1,769.3	51,412.9
Others					
Back Bay	0	3,147.7	5,910.2	4.2	9,062.1
Prudential - Copley	0	4,058.6	8,354.1	5,713.7	18,126.4
East Cambridge - East Somerville	0	5,239.6	8,244.1	92.4	13,576.1
Subtotal	0	12,445.9	22,508.4	5,810.3	40,764.6
Study Area Total	1,742.0	83,169.9	242,795.1	23,576.9	351,284.4

Source: Bechtel Parsons/Brinckerhoff

Table 3.18

DAILY VEHICLE HOURS TRAVELLED (VHT) BY COMMUNITY AND FACILITY TYPE FOR 2010 NO-BUILD CONDITIONS

Project Area	HOV	Expressway	Local Street	Ramp	Total
Area North Of Causeway Street					
Charlestown (excluding Navy Yard)	0	13,755.8	18,253.1	46611.5	36,600.4
Charlestown Navy Yard	0	890.8	1,953.6	0	2,844.4
North Station	0	3,784.8	11,003.4	2,952.4	17,740.6
West End	0	4,280.6	4,550.5	721.5	9,552.6
Subtotal	0	22,692.0	35,760.6	8,285.4	667,738.0
Central Area					
Government Center	0	2,122.1	9,741.6	477.6	12,341.3
North End	0	4,218.0	7,538.5	673.2	12,429.7
Waterfront	0	9,842.5	8,401.0	3,352.5	21,596.0
Financial District	0	0	16,234.5	227.3	16,461.8
Midtown - Retail	0	0	12,896.1	0	12,896.1
Chinatown - Bay Village	0	1,412.8	4,313.9	0	5,726.7
South Station	0	7,338.8	7,625.6	5,452.7	20,717.1
Beacon Hill	0	3,084.3	14,227.8	1,923.2	19,235.3
Subtotal	0	28,018.5	80,979.0	12,406.5	121,404.0
I-93/I-90 Interchange And I-93 Massachusetts Avenue Interchange Area					
South Bay/Newmarket	0	10,742.4	16,627.2	1,231.8	28,601.4
South End	0	8,380.9	21,583.9	233.5	30,198.3
Subtotal	0	19,123.3	38,211.1	1,465.3	58,799.7
South Boston					
South Boston Industrial Area	0	0	14,171.4	0	14,171.4
South Boston Lower End	0	0	9,456.7	0	9,456.7
South Boston: City Point	0	0	33,558.6	0	66,558.6
Subtotal	0	0	57,186.7	0	57,186.7

Table 3.18 (Cont.)

DAILY VEHICLE HOURS TRAVELLED (VHT) BY COMMUNITY AND FACILITY TYPE FOR 2010 NO-BUILD CONDITIONS

Project Area	HOV	Expressway	Local Street	Ramp	Total
East Boston/Logan Airport					
East Boston-Jeffries Point	0	3,326.2	1,895.6	0	5,221.8
East Boston-Eagle Hill	0	1,549.0	13,843.8	2,136.9	14,478.1
East Boston-Logan Airport	0	3,011.1	14,730.5	2,136.9	19,878.5
East Boston-Orient Heights	0	4,434.0	3,605.1	3.7	8,042.8
Subtotal	0	12,320.3	34,075.0	2,225.9	48,621.2
Others					
Back Bay	0	3,920.2	13,861.7	7,256.6	25,039.2
Prudential - Copley	0	5,196.4	11,518.6	351.9	17,066.9
East Cambridge - East Somerville	0	0	97,761.1	0	97,761.1
Subtotal	0	9,117.3	123,141.4	7,605.5	139,867.2
Study Area Total	0	91,271.4	369,353.8	31,991.6	492,616.8

Source: Bechtel Parsons/Brinckerhoff

street and community impacts which would be greatly exacerbated in the 2010 baseline condition. In contrast, with construction of the South Boston Bypass Road in the Proposed Action, these conditions are expected to be significantly alleviated.

The Proposed Action will add new connections from the southerly terminus of the South Boston Haul Road to the I-93 Interchange of Massachusetts Avenue/Melnea Cass Boulevard.

The resulting roadway, called the South Boston Bypass Road, will serve as a truck route for South Boston construction activities in the early to mid-1990s, diverting trucks from South Boston residential area streets. With the completion of the Third Harbor Tunnel in late 1994, and extension of the Haul Road alignment to the Southeast Expressway's Frontage Road, the Bypass Road will carry commercial vehicles destined for the tunnel as well as the South Boston industrial sector. The roadway is also expected to divert 20 percent of the AM peak hour traffic (400 vehicles) and 17 percent of the PM peak hour traffic (200 vehicles), from the I-93 northbound to I-90 eastbound move. Approximately 50 percent of the vehicles diverted from I-93 northbound during the AM peak hour and 65 percent during the PM peak hour will be trucks.

The diversion of large numbers of trucks from I-93 northbound to the South Boston Bypass Road will relieve traffic substantially on I-93 northbound and I-90 eastbound during peak hours. The percentage of trucks on the Bypass Road will be 53 percent during the AM peak hour, 49 percent during the PM peak hour, and 67 percent on a daily basis. Trucks will constitute a lower percentage of the total traffic in the peak hours, because HOV traffic will be heavier during these periods.

East Boston/Logan Airport. Overall traffic to and from this area is expected to increase considerably by the year 2010. This also is one of the few subareas where industrial development is projected to proceed at a faster rate than growth of other land uses. Consequently, in 2010 truck traffic can be expected to constitute a larger share of total traffic in this area than at present.

The Proposed Action will reduce congestion markedly in the Sumner/Callahan Tunnels. While the primary reason for the improvement will be increased total capacity on the Central Artery and cross-harbor links, diversion of truck traffic away from the existing tunnels will be a contributing factor. The Third Harbor Tunnel will provide direct links for trucks between East Boston and the South Boston commercial sector and beyond, via the Seaport Access Road and the South Boston Bypass Road.

Inflammable Cargo Routes. Vehicles transporting inflammable materials will be prohibited from in-tunnel sections of the Artery/Tunnel Project. These sections include I-93 southbound from Causeway Street through the existing Dewey Square tunnel southbound, I-93 northbound from the I-93/I-90 interchange to Causeway Street, and I-90 east of the I-93 interchange. Compared to the 2010 baseline condition, the impact of the Proposed Action will be to prohibit vehicles carrying inflammable cargoes from using the portion of the Central Artery north of the Dewey Square tunnel, and to provide a new route through South Boston, in the form of the South Boston Bypass Road. Inflammable cargoes cannot be transported currently through the Dewey Square tunnel, and vehicles carrying these materials use alternate routes on surface streets such as High Street, Purchase Street, Atlantic Avenue, the Surface Artery, and Kneeland Street. With the prohibition of inflammable

cargoes from the northern section of the Central Artery, such movements will be shifted onto surface arterials in this area as well, principally the Surface Artery, and Purchase, Merrimac and Congress Streets. The extension northward to Causeway Street and upgrading of the surface street system, to be implemented in conjunction with the Proposed Action, will facilitate inflammable material transport. Vehicles carrying inflammable cargoes will connect to the Tobin Bridge via I-93, using the Traverse Street entrance ramp to the Central Artery. Additional use of the existing alternate truck route through Cambridge is not expected, because vehicles carrying inflammable cargoes already are prohibited from the Massachusetts Turnpike extension as well as Dewey Square, and therefore do not have highway access to the northern segment of the Central Artery.

3.2.5(d) Safety

The reconstructed Central Artery will operate with far fewer accidents than the existing facility, due primarily to improved geometry and expanded capacity. Using accident formulas based on national statistics and conditions, the annual accident rate on the Central Artery is forecast to decrease by 35 percent with the new facility in place, from 5.47 annual accidents per million VMT in the 2010 baseline to 3.54 per million VMT. Accident rates were estimated for mainline highway segments in the Proposed Action and 2010 baseline conditions as a function of the following factors: type of roadway facility; vehicular volume; number of lanes; frequency and length of weaving sections; vertical and horizontal alignment; presence of diverge and merge points; and whether or not a roadway section is in tunnel.

One of the principal geometric characteristics contributing to safer traffic operations on the new Central Artery will be a reduction in the number and severity of weaves. (The shorter the distance of a weaving section, the greater is its potential to cause accidents; if a weaving section is longer than 1,000 feet, its impact on accidents rates is negligible). In the 2010 baseline condition, as today, the Central Artery would include 11 weave sections, eight of which would be less than 1,000 feet long. In the case of the Proposed Action, the Central Artery will have only three weave sections, all of which will be greater than 1,000 feet, and therefore have no significant role in causing accidents.

Another important factor is the length of acceleration and deceleration lanes for ramp merges and diverges, respectively. Research has shown that acceleration lanes less than 700 feet in length and deceleration lanes less than 900 feet in length can contribute significantly to the generation of accidents. The 2010 baseline Central Artery alignment would have 15 acceleration lanes and 7 deceleration lanes of less than 700 and 900 feet respectively. In contrast, the Proposed Action will have no acceleration lanes shorter than 700 feet, and only four deceleration lanes shorter than 900 feet.

The expansion of capacity on the Central Artery also will serve to reduce accident rates. While the Central Artery will carry higher total traffic volumes under the Proposed Action, compared to the 2010 baseline, traffic volumes per lane will decline by 29 percent. As a result, the density of traffic flow will decrease, yielding improved spacing between vehicles and fewer accidents.

Taking into account all of the geometric and capacity characteristics cited earlier, the estimated number of annual accidents on the Central Artery will decrease from 1,193 in the 2010 baseline condition to 810 under the Proposed Action. On the entire study area expressway system, including the cross-harbor tunnels, the accident rate will decline by

13 percent with the Proposed Action in place (see Table 3.19). A total of 754 million VMT and 2,700 accidents are projected to occur on study area expressways in the 2010 baseline condition, compared to 931 million VMT and 2,900 accidents with the Proposed Action in place. The increase in VMT on the expressway system is due to the shift of traffic away from local streets.

Accidents were forecast for four other facility types in addition to mainline expressways; ramps, major arterials, collector arterials, and local streets. (The accident rates for arterial and local streets are existing statewide averages for urban facilities, and are valid as a basis for comparing the relative frequency of accidents between the 2010 baseline and Proposed Action, as a function of shifts in VMT among the various types of facilities.)

Taking into account all the roadways in the study area network, the number of annual accidents is forecast to decrease by 4 percent, from 7,156 to 6,862 (see Table 3.20). The overall reduction in accident frequency is caused both by the substantial improvement in Central Artery geometry, and the diversion of traffic to the Artery and other mainline highway segments away from local roads. Accident rates for arterials and local streets are higher than those for expressways and ramps. The overall study area network accident rate is forecast to decrease 9 percent with the Proposed Action in place, compared to the 2010 baseline, from 4.20 to 3.81 accidents per million VMT.

3.2.5(e) Replacement Parking

Project Impacts. The Proposed Action will result in the permanent displacement of approximately 2,260 publicly owned parking spaces throughout the entire study area, based on current construction plans. In addition, up to approximately 1,420 privately owned spaces are likely to be permanently displaced. An inventory of permanent parking impacts by parcel is provided in Table 3.21. The locations of affected parcels are shown in Figure 3.23. Please see the Replacement Parking section of the Construction Appendix for additional information. Parking supply that will be displaced during construction but restored once construction is complete is discussed in Chapter 20. The Commonwealth of Massachusetts will provide functional replacement for permanently displaced parking spaces that are publicly owned and used by the general public. The majority of these spaces are in the downtown area, and will be replaced in two new parking facilities to be constructed by the Commonwealth: a 1,300-space garage at North Station; and a 340-space garage on Parcel 7, in the Haymarket area. Owners of private parking facilities will receive just compensation at fair market value for property taken by the project, as is the case with all property acquisitions. Project impacts by subarea are described below.

Downtown Boston. In downtown Boston, encompassing the section of the alignment from the North Station Area to Kneeland Street, approximately 760 spaces will be displaced that are publicly owned and used by the general public. These spaces will be replaced in the North Station garage, to be constructed by the MBTA, and the Parcel 7 garage to be built by the Department on the site bounded by Blackstone, Hanover, Congress and New Sudbury Streets.

The North Station garage is planned to open in 1992. The garage site is the MBTA-owned parcel immediately behind the existing Boston Garden, as shown in Figure 3.22. The spaces in the new garage will function as replacements for spaces taken by the project or the MBTA, which is undertaking station and rail construction work in this area.

Table 3.19

PROJECTED EXPRESSWAY ACCIDENTS AND ACCIDENT RATES

Facility	Million VMT	Accidents	Accident Rate (incidents per 1 million VMT)
2010 Future Baseline			
Central Artery	218	1,183	5.47
Sumner/Callahan	41	199	4.85
Remainder	495	1,308	2.64
Total	754	2,700	3.58
2010 Proposed Action			
Central Artery	229	810	3.54
Sumner/Callahan	29	111	3.83
I-93/I-90 to Rte. 1A	85	320	3.76
Third Harbor Tunnel	33	149	4.52
Toll Plaza	N/A	44	N/A
Remainder	555	1,466	2.64
Total	931	2,900	3.11

1. N/A = Not applicable

Source: Bechtel/Parsons Brinckerhoff

Table 3.20

PROJECTED SYSTEMWIDE ACCIDENTS AND ACCIDENT RATES

Facility Type	Estimated Annual VMT[1] Millions	% Of Total Annual VMT	Average Accident Rate[2]	Estimated Annual Accidents	% Of Total Annual Accident
2010 Future Baseline:					
Expressway[4]	754	44.3	3.58	2,700	37.7
Ramp[3]	113	6.6	1.64	185	2.6
Major Arterial	349	20.5	4.03	1,408	19.7
Collector Arterial	378	22.2	5.39	2,037	28.5
Local Street	109	6.4	7.57	825	11.5
Total	1,703	100.0	4.20	7,156	100.0
2010 Proposed Action					
Expressway[4]	931	51.7	3.11	2,900	42.3
Ramp[3]	136	7.6	1.64	223	3.3
Major Arterial	318	17.6	4.03	1,282	18.7
Collector Arterial	319	17.7	5.39	1,719	26.1
Local Street	98	5.4	7.57	738	10.8
Total	1,801	100.0	3.81	6,862	100.0

1. Estimated annual vehicle miles travelled (VMT) is based on output from the TRANPLAN traffic assignment model developed for this project
2. Average accident rate per million VMT by facility type for nonfreeway and ramp facilities is derived from 1985 data furnished by the Department for State facilities in urban areas
3. Average accident rate for ramps was derived from research conducted to develop an accident model for the Central Artery project calibrated to the Department's rates. Source: "A Procedure for Evaluating Safety Effectiveness of Freeway System Alternatives -- The Central Artery Accident Model", April 1987

Source: Bechtel/Parsons Brinckerhoff

Table 3.21

PERMANENT PARKING DISPLACEMENTS BY PROPOSED ACTION

Parcel[1]	No. of Spaces Displaced: Public Property – Public Access	Public Property – Private Access	Private Property
North of Causeway/Downtown			
1. Guilford	--	--	65
2. DPW	--	31	--
3. Martha Way	78	--	--
4. Lomasney Street	--	72	--
5. MDC	--	143	--
6. Charles River Building	--	--	100
7. Anelex	--	--	290
8. Beverly Street	26	--	--
9. Beverly Street	7	--	--
10. Causeway-Valenti Lot	150	--	--
11. Causeway-Haverhill Lot	74	--	--
12. Valenti-North Washington	63	--	--
13. Cross-North Washington	65	--	--
14. Cross-Blackstone Lot	207	--	--
15. City Employee Lot	--	19	--
16. Cross On-Street: Fulton to Commercial	14	--	--
17. Cross On-Street: Commercial to Atlantic	12	--	--
18. High-Atlantic Lot	60	--	--
19. Boston Edison Lot	--	--	272
I-93/I-90 Interchange Area			
20. Wang	--	--	140
21. Under Viaduct (no. of Mass Ave Interchange)	--	252	--
22. Next to Viaduct (no. of Mass Ave Interchange)	--	75	--
South Boston			
23. Conrail	--	15	--
24. Off Congress	--	57	--
25. Postal Service	--	275	--
26. Contos	--	--	332
27. World Trade Center	220	304	--
28. U.S. Army	--	33	--

Table 3.21 (Cont.)

PERMANENT PARKING DISPLACEMENTS
BY PROPOSED ACTION

Parcel[1]	No. of Spaces Displaced		
	Public Property		Private Property
	Public Access	Private Access	
East Boston			
29. Rental Overflow (MPA)[2]	--	35	--
30. Eastern Res (MPA)	--	28	--
31. Taxis (MPA)	--	68	--
32. Eastern Terminal (MPA)	15	--	--
33. Hilton (MPA)	--	54	--
34. AA Hangar (MPA)	--	55	--
35. Ciampa Realty	--	--	20
36. Pan Am Air Cargo (MPA)	--	17	--
37. Delta Reservations (MPA)	--	42	--
38. Behind Delta Reservations	--	--	25
39. Park and Fly	--	--	170
Total	--	2,262	1,414

1. See Figure 3.22 for location of affected parcels
2. MPA is an abbreviation for Massport

Source: Bechtel/Parsons Brinckerhoff

The Parcel 7 garage will replace spaces under the Central Artery adjacent to the North End. Parcel 7 currently serves as a 150-space parking lot for city employees. Since Parcel 7 had already been designated development site, however, parking for this purpose is a temporary use and will not be replaced.

Interchange Area. The interchange area extends from Kneeland Street to the Massachusetts Avenue interchange, and includes the I-93/I-90 Interchange. A total of 330 parking spaces on publicly owned land and 140 spaces on privately owned land will be permanently displaced by the project. The 330 spaces have been provided on a temporary basis to the hospitals in the area. These spaces are on land owned by the Commonwealth, but are not governed by a formal lease. The spaces, therefore, will not be included in a replacement program for the Artery/Tunnel Project. The Commonwealth recognizes the serious nature of this impact, however, and will work with the City of Boston to provide parking for the hospitals in the area.

South Boston. Approximately 910 spaces on public property will be displaced in South Boston to allow for the construction of the Third Harbor Tunnel and connecting Seaport Access Road. These displacements include existing spaces on property owned by the U.S. Postal Service and Massport. The spaces are not available for use by the general public. The Commonwealth will work with both the Postal Service and Massport to reduce parking impacts. Massport is planning to build a garage in the Commonwealth Flats area independently of the Artery/Tunnel Project, which may replace losses in parking supply on a permanent basis. The 330 permanently impacted spaces on private property in South Boston will be mitigated through just compensation to property owners.

East Boston. In East Boston 310 spaces on publicly owned land will be permanently displaced. All of these spaces are at Logan Airport and on land owned by Massport. These spaces will be replaced by a program to be developed jointly by Massport and the Commonwealth. An additional 220 spaces on private property will be displaced permanently, and mitigated through just compensation to property owners.

3.2.6 Project Impacts On Other Transportation Facilities

A project of the Proposed Action's scale can be expected to have widespread impacts on not only highway travel, but other transportation modes. The Boston metropolitan area is served by a comprehensive multimodal transportation system, the whole of which is affected by changes in its constituent parts. This section describes the changes to the public transportation system and pedestrian circulation which will result from the Proposed Action, taking into account physical, operational, and patronage impacts. Planned improvements to the public transportation system within the analysis timeframe of this document, i.e., through the year 2010, are described in Section 3.3.

3.2.6(a) Transit Ridership

The Artery/Tunnel Project will result in a major expansion of capacity on the expressway system in the Boston metropolitan area. While improved highway travel is the objective of the project, any major upgrading of the highway system has the potential to induce some travelers who would otherwise use nonhighway based public transportation to divert to automobiles.

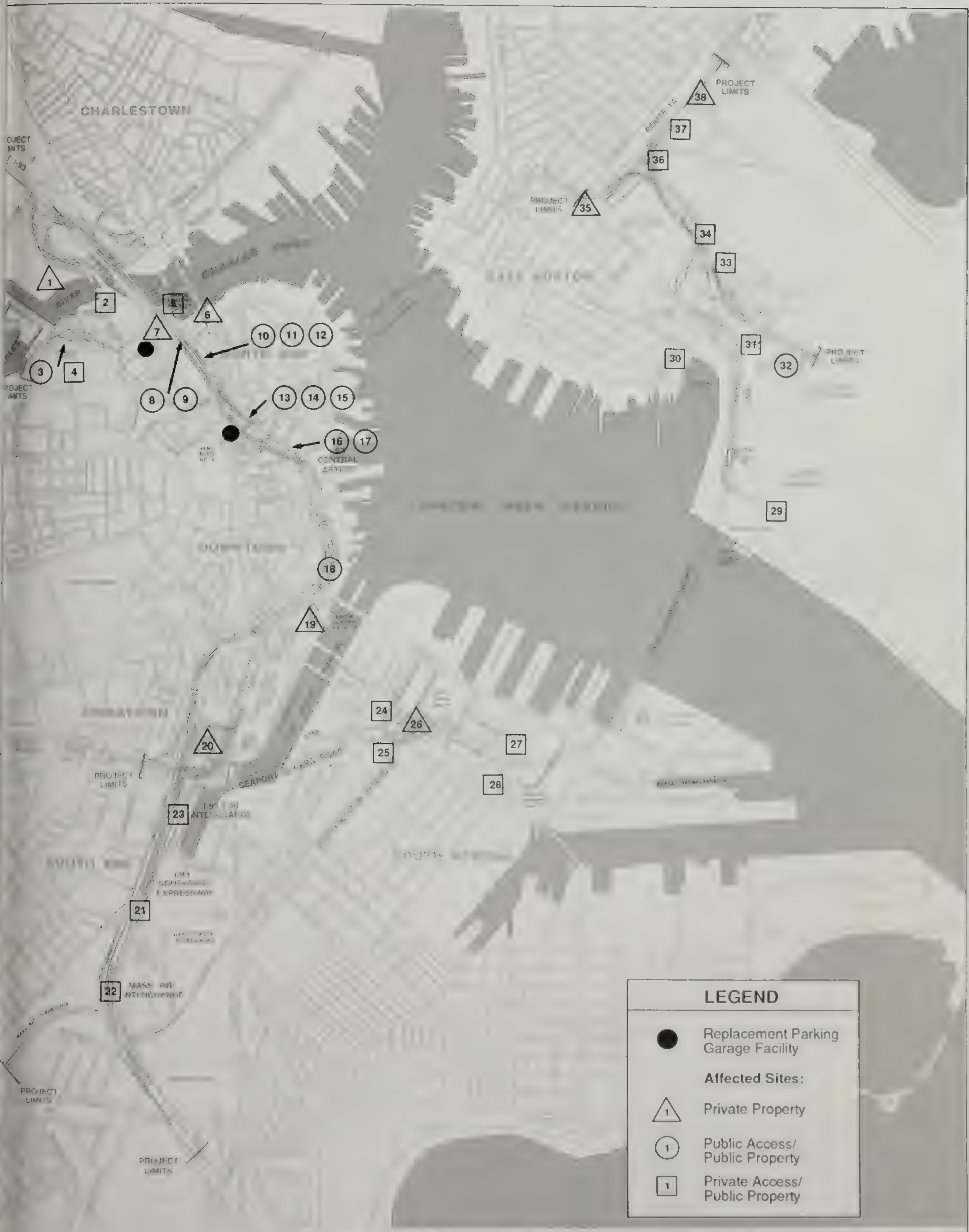

FIGURE 3.23

Permanent Parking Impacts And Replacement Sites

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The Central Transportation Planning Staff (CTPS), which serves as the professional staff of the Boston Metropolitan Planning Organization (MPO), forecast the impact on transit ridership of changes in highway travel times associated with the Proposed Action. The method used was a standard "mode choice" forecasting model, in which varying percentages of the travelling public are assigned either to automobiles or public transportation, based on the monetary cost and travel time characteristics associated with each of these two basic travel modes.

Table 3.22 compares the number of transit and automobile trips for 1987, the 2010 baseline condition, and the Proposed Action. Between 1987 and the 2010 baseline condition, the number of daily inbound transit trips is estimated to increase by approximately 31 percent throughout the study area, to 464,742, and 22 percent in Boston Proper, to 302,144. The Proposed Action will result in a reduction in transit ridership of approximately 1,000 trips per day in the study area, relative to the 2010 baseline condition, which translates into a transit mode share decrease of less than 1 percent. In Boston Proper, transit ridership will decline by about 200 trips, and the transit mode share will decline by under 1 percent. However, given year-to-year fluctuations in transit ridership by several percent, this phenomenon may not be statistically discernible.

An additional component of transit ridership, in the case of the Proposed Action only, will be the increase in bus use because of the HOV system. Taking these trips into account, many of which would otherwise be made by automobile, transit ridership and mode share are essentially unchanged as a result of the Proposed Action.

During the project construction period, there will be an opportunity to increase transit ridership at higher rates than those forecast. This was the experience during 1984-85, when the use of expanded public transportation services climbed as a result of Southeast Expressway construction.

3.2.6(b) Impacts To MBTA Rapid Transit And Commuter Rail Facilities
The Proposed Action will have impacts on MBTA rail facilities at 30 locations. The vast majority of these impacts will involve temporary relocations during the project construction period and are described in Chapter 20. Permanent impacts will occur at the following locations and are described below by subarea:

- o Haymarket Orange/Green Line station
- o Atlantic Avenue at South Station Transportation Center
- o Airport Blue Line station

Area North Of Causeway Street. The Science Park Green Line Station, on elevated viaduct bisecting Leverett Circle, will require structural underpinning during construction of the underlying eastbound Leverett Circle underpass. The Proposed Action will have no other direct impact on the station.

Central Area. The Proposed Action will have a beneficial permanent impact on the Orange/Green Line Haymarket station. The existing City Hall entrance/exit on Congress Street and the station mezzanine will be renovated as a part of the development of the Parcel 7 replacement garage. Passengers entering and leaving the station will pass through a newly created mezzanine-level marketplace, which will provide a substantially improved

Table 3.22

COMPARISON OF TRANSIT AND AUTO TRIPS TO STUDY AREA AND BOSTON PROPER[1], 1987, 2010 BASELINE, AND 2010 BUILD

	Transit Trips[2]	Transit Mode Share (%)	Auto Trips[2,3]	Auto Mode Share (%)
Study Area				
1987	354,020	33.4	705,951	66.6
2010 Baseline	464,742	34.3	888,901	65.7
2010 Proposed Action	463,777	34.3	889,866	65.7
Boston Proper[1]				
1987	248,615	39.0	389,408	61.0
2010 Baseline	302,144	38.2	489,420	61.8
2010 Proposed Action	301,932	38.1	489,661	61.9

1. Area defined by Massachusetts Avenue, Charles River, Boston Harbor, and Fort Point Channel
2. One-way trips to the study area
3. Excludes intrazonal and Logan Airport trips, as well as HOV trips induced by Artery/Tunnel Project HOV lanes

Source: Central Transportation Planning Staff

visual environment. The station will also be made handicapped-accessible, with elevators provided between the street and platform levels.

The project will have a major beneficial impact on the South Station Transportation Center (SSTC) as well. Ramps will be constructed as a part of the Proposed Action, connecting the SSTC with I-93, I-90, and Kneeland Street. These ramps will provide access to and egress from the parking garage and bus terminal. The ramps will be used by HOVs, including buses, and general purpose traffic. The ramp connections are essential to the operation of the parking garage, which will create a park-and-ride option at South Station. Those parking at the garage will have a convenient transfer to the Red Line, which may promote Red Line ridership.

East Boston/Logan Airport. The Proposed Action will result in substantially improved access at the Blue Line Airport station, where a new bus loop will be provided connecting to the internal airport circulation system. Ingress and egress at the station also will be modified to provide cross-platform transfers between subway and bus. The improved transfer, which will reduce the need to climb stairs, will be particularly beneficial to disabled persons and passengers carrying luggage. Changes to the station, financed by the Proposed Action, will allow the operation of high platform buses, which will further facilitate baggage carrying and handicapped access. The acquisition of special buses with left-hand doors will be required. The overall impact will be to improve access to/from the airport via the Blue Line, and encourage the use of transit for airport access. Moreover, project roadways in this area have been designed to accommodate possible future transit connections between the station and the airport, including a rail transit line or people mover.

3.2.6(c) Impacts To Bus Routes And Operations

The greatest impact of the Proposed Action on bus operations will be the provision of an extensive HOV system. The HOV system will provide for improved bus travel times among services connecting downtown, areas to the south of Boston, South Boston, and Logan Airport. Lower travel times will allow for more efficient operations and frequent scheduling, which should in turn result in increased ridership and reduced use of low-occupancy automobiles.

Another project-related impact will be the rerouting of buses which currently travel between points north of downtown Boston and the Haymarket bus terminal. Under the Proposed Action, the existing off-ramp to New Chardon Street will be eliminated, creating a need to reroute the bus lines destined to the Haymarket Station area from I-93 south (Routes 325, 326, 352, 353, and 354). To address this need, the development of a bus terminal is under consideration in the North Station area, as part of a new intermodal "superstation" designed for convenient transfer between bus, Orange/Green Line rapid transit, and commuter rail. Buses would travel to the station by exiting I-93 via the CANA loop ramp to City Square, from where they either would cross the Charles River on the North Washington Street bridge, before turning right onto Causeway Street, or use the Merrimac Street system. The return route would be via the Surface Artery and the Traverse Street on-ramp to I-93 north. Because of the improved intermodal connection, the net result to bus operations generally would be positive, and of benefit to bus riders.

An additional potential change is that some buses entering downtown via the Sumner Tunnel and the Charlestown bridge might be rerouted to South Station via the Third Harbor Tunnel

and Seaport Access Road. This rerouting is an option that could be implemented by the MBTA if found conducive to improved bus operations. There will be no other significant impacts to bus routes or operations, beyond those associated with the SSTC ramps, HOV system, or Airport Blue Line station, all of which were described earlier in this section.

3.2.6(d) Water Transportation

The existing network of water transportation services is likely to be expanded substantially by 2010, with support from the Commonwealth. There is likely to be new service between the South Shore, downtown Boston, and Logan Airport, as well as new Inner Harbor services.

The Third Harbor Tunnel and HOV system will compete with South Shore-based and Logan Airport-oriented water transportation routes and may reduce the potential market for these services, to some extent. It is anticipated, however, that these services will retain a substantial market among those riders whose origins and destinations are within close proximity of ferry terminals. The existing water transportation market share, while growing, is small compared to that of other public transportation modes or automobiles.

As a part of the Proposed Action, new docking facilities will be provided at Lovejoy Wharf near North Station, for use by passenger ferries. It is anticipated that new privately operated water transportation services will connect this terminal and the airport, downtown Boston, Charlestown, and/or South Boston.

3.2.6(e) Air Transportation

In the 2010 baseline case, annual passenger volumes at Logan Airport are projected to increase to 37.5 million, an increase of 59 percent over 1988 volumes. Access to and from the airport would deteriorate markedly relative even to today's highly congested conditions, in the absence of the Proposed Action. The Sumner Tunnel, which is currently the location of 9 hours of congestion each day due to traffic delays on the connecting Central Artery, would experience stop-and-go, highly unstable traffic flows for 12 hours per day by 2010. Congestion in the Callahan Tunnel also would increase substantially, from 4 to 10 hours per day. Moreover, the overflow of traffic from the tunnels and Route 1A to alternate routes through East Boston would worsen, aggravating existing local traffic problems and attendant air pollution and noise levels.

Airport egress routes are particularly vulnerable to delays because traffic leaving the airport tends to concentrate in surges. Pulses of this type could become a significant problem in future years. As the number of air travellers grows, more flights will be added at Logan; however, Logan's capacity to handle airport operations is limited by the number of terminal gates, weather conditions, noise impact restrictions, and the air traffic control system. Airport planners expect that the airlines will compensate for this by introducing larger planes carrying more passengers. This will create sharper peaks in the number of passengers and vehicles moving through the airport, especially as large clusters of arriving passengers leave the airport in automobiles, buses, and taxis.

The Artery/Tunnel Project will relieve much of the congestion affecting airport traffic and significantly improve access to Logan Airport. The Third Harbor Tunnel will carry most of the airport-oriented traffic from areas to the south of the Central Business District and a large percentage of traffic reaching Logan from the western suburbs. Expansion of capacity on northern sections of the Central Artery will alleviate the bottleneck that is the

principal cause of delay in the Sumner Tunnel. With the diversion of traffic to the Third Harbor Tunnel and improvement to the Central Artery, delays to airport traffic using the Sumner/Callahan Tunnels will be cut substantially.

The Proposed Action also will improve airport access through its provision of an HOV system, which will reduce travel times for eligible categories of vehicles. I-90 on the East Boston side of the tunnel will be designed to connect to a possible future HOV airport ramp in the northbound direction, which would be developed by Massport independently of the Artery/Tunnel Project. An HOV lane also will be designated in the westbound direction on the approach to the toll booths. At the toll booths, it will be possible to provide HOVs with preferential entry to the Third Harbor Tunnel approach. The eastbound entry to the Third Harbor Tunnel, in South Boston, also will have a preferential HOV entry capability. It is envisioned currently that the HOV system will be open to buses, taxis, limousines, and carpools.

The reduced travel times made possible by the HOV system will act as a strong incentive to use buses and other eligible vehicles, rather than private automobiles, for travel to and from the airport. This is important not only to reduce airport-oriented vehicular traffic but also to lower parking demand. The commercial parking supply at Logan Airport currently is limited to 10,215 spaces, in accordance with a parking freeze mandated by the U.S. Environmental Protection Agency (EPA). Massport has applied to the EPA for an amendment which would restructure the freeze concept and expand the categories of parking covered by the freeze to include approximately 2,000 off-airport park-and-fly spaces, 2,000 on-airport spaces currently used for overflow demand, and 7,100 employee spaces, all of which are presently exempt from the freeze. Even allowing for these future changes in the freeze inventory, the airport will be able to accommodate anticipated future growth in passenger volumes only if more employees and passengers use alternative transportation modes that do not require long-term parking facilities.

For the airport to accommodate projected growth in air passenger volumes, the number of passengers arriving by bus and limousines must increase substantially by year 2010. Taxis will absorb some of the passenger growth. The subway, which carries about 8 percent of ground passengers today, also will have to absorb some of the passenger growth. Subway ridership through the Blue Line Airport station could double by 2010, but its overall impact would be modest because over half of Logan's air passengers live outside Route 128 and beyond the effective reach of the MBTA rapid transit lines. Commuter rail also may be attractive to air travellers when direct airport bus links are established by Massport from North and South Stations. Massport has undertaken a dozen major initiatives over the last decade to increase transit ridership to the airport. The agency is planning to expand its existing remote parking/express bus operations into a system of satellite regional transportation centers, which will serve as nodes for high-occupancy vehicle services. The HOV system incorporated into the Proposed Action will be designed to accommodate HOVs travelling between these facilities and the airport ground transportation system.

3.2.6(f) Pedestrian Circulation

The Artery/Tunnel Project will result in major improvements to pedestrian circulation. These improvements will include new, shorter crossing routes and aesthetic improvements to existing pedestrian routes. Figure 3.24 illustrates new pedestrian connections created by the Proposed Action.

Area North Of Causeway Street. On the north side of the Charles River, Paul Revere Landing Park will be extended westerly under the new Central Artery bridges along the river; a new landscaped walkway/bikeway will be included and will cross over the MBTA commuter railroad tracks on a new pedestrian bridge. This new construction over the railroad will provide a critical link for pedestrian and bicycle movement along the Charles River from the Charlestown Navy Yard to the planned extension of the Charles River Esplanade. West of the railroad tracks on the south side of the river, a walkway will parallel the Central Artery transition section from Causeway Street to the river. The walkway will lead to the Charles River dam walkway, connecting to Charlestown via Paul Revere Landing Park on the north bank. A pedestrian walkway also will be constructed to provide access to a new commuter ferry landing on Lovejoy Wharf. Open space with a walkway/bikeway can be created after construction along the south bank to the MBTA tracks. A future separate project to be built by others in air rights over the MBTA commuter rail tracks at North Station is expected to include a pedestrian bridge over the MBTA tracks. This crossing will connect the walkways on either side of the MBTA commuter rail trestle along the south side of the river. [See Chapter B1 in Part II of the SEIS/R for a complete discussion of park development plans, project impacts, and proposed mitigation actions in this area.]

Central Area. Due to its location underground, the depressed Central Artery will result in a substantial improvement to pedestrian circulation along and across its route. The aesthetic improvements resulting from removal of the elevated highway structure (discussed further in Chapter 9, Visual Characteristics), will improve pedestrian conditions from Causeway Street to Congress Street. Noise, shadows, and the visual barrier caused by the existing viaduct will be removed. Pedestrians will cross the new locations of entrance and exit ramps to the Central Artery tunnel.

In addition to the overall aesthetic improvement in the Central Area, specific improvements to pedestrian crossing routes will occur as well. The most substantial improvement will be pedestrian routes across the new Surface Artery connecting downtown with the waterfront. A new crossing of the Central Artery from Traverse Street to Thatcher and North Washington Streets could be possible, contingent on plans by the MBTA for a possible joint development project above the new Green Line/Orange Line underground station at North Station. A direct pedestrian connection along Hanover Street will supplement the present route from Salem Street to the Haymarket area and create good pedestrian access from Endicott Street to Parcel 7 as well. Ramps from the Sumner and Callahan Tunnels will be relocated underground, opening up new pedestrian routes along and across Cross Street, removing the hazards of crossing traffic at the mouths of these tunnels.

At Rowes Wharf, the surface street pattern will be simplified, eliminating one of the three street crossings currently necessary and allowing for an improved plaza over the depressed Artery in front of the Rowes Wharf arch. The proposed relocated Northern Avenue will continue across the Central Artery aligning with Oliver Street on the west side. This will create a new pedestrian route across the Central Artery, replacing the Oliver Street pedestrian bridge located 150 feet to the south. Finally, Pearl Street will be extended above the Central Artery, creating an additional pedestrian crossing.

In addition to new pedestrian routes that will be developed where new streets cross the Central Artery, more pedestrian connections will be developed, where appropriate, at midblock locations, either through parks and plazas, along open pedestrian streets, or

FIGURE 3.24

New Pedestrian Connections

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through buildings. Because the Central Artery design allows for a broad range of development options on the surface, a definitive future layout of uses at ground level above the tunnel has not been developed. However, current design objectives of the City of Boston encourage the maintenance of view corridors, particularly via pedestrian ways that align with streets that approach the Central Artery but do not cross it. Such midblock pedestrian crossings may occur at Fulton, Commercial, and Central Streets, and from International Place to Fosters Wharf (the Ferry Boat Terminal).

I-93/I-90 Interchange And Massachusetts Avenue Interchange. There is currently very little pedestrian movement along or across this project subarea. Local streets will be extended over the I-93/I-90 Interchange, expanding the number of pedestrian crossings in this area.

Improvements to the southern end of Fort Point Channel are anticipated as a part of the Artery/Tunnel Project, although details have not yet been determined. Possible efforts under consideration in this area include walkways along the channel from the north and one or more pedestrian bridges over highway ramps and railroad tracks from the west, connecting areas to the west with the channel area. Development within the loop of ramps around ventilation building 2 is also under consideration and may include pedestrian bridges to the west and/or north, in addition to access along Atlantic Avenue.

South Boston/South Boston Bypass Road. The South Boston area of the project is located within an industrial area with little pedestrian movement today. All current pedestrian routes, which follow streets, will remain or be restored in the future. However, major redevelopment of this area is expected and is reflected in City land use plans. As a result, pedestrian activity in the area will increase dramatically. The Department and its management consultant are working closely with the City and Massport, a major land owner in this area, to provide for a future pedestrian environment in this area that is supportive of development plans.

The South Boston Bypass Road will operate partially through an existing railroad cut between Dorchester Avenue and West Second Street; the alignment passes through a residential area where pedestrians cross on street bridges overhead. Most of these bridges, spaced one block apart, will remain in the future, and pedestrian movement will not be affected. (Three of the bridges will be removed by a separate Department project.)

Third Harbor Tunnel. The entire project will be underground; most of it under Boston Harbor. There are no pedestrian crossings in this area. Pedestrian access to the tunnel will be provided only for maintenance and safety purposes; the general public will not be allowed to enter the tunnel on foot. No bicycles will be allowed in the tunnel. However, reconfiguration of local service roads and the airport access spine roadways will result in improved pedestrian access between areas north and south of the access roadway.

East Boston/Logan Airport. The project will create a major improvement in the quality of pedestrian conditions at East Boston Memorial Stadium Park. Removal of the existing airport entrance roadway and potential expansion of East Boston Memorial Stadium Park to Porter Street on the south will substantially improve pedestrian access both to the park and to the MBTA Airport station on the Blue Line from the southwest. The park will be enlarged to include the area currently occupied by the airport access road and State-owned land

stretching to Porter Street between Cottage and Geneva Streets. New pedestrian access will be available at this point to the park and through the park to the Blue Line station. [For more detailed information on project impacts on parkland in East Boston, see the Section 4(f) Evaluation in Part III of the SEIS/R.]

Most of the alignment in East Boston will be placed through airport property or along roadway areas. There is little pedestrian movement in this area. Although pedestrian routes in airport service areas will shift with the relocation of some roadways, pedestrian access will remain similar to the conditions present today.

3.2.6(g) Bicycling

The Proposed Action will improve bicycle operating conditions through several specific actions that will foster safer use of bicycles in more pleasant surroundings. Throughout the study area, the Proposed Action will lower traffic volumes on local streets, which will allow for freer bicycle movement. In the Area North of Causeway Street, a new walkway/bikeway will be constructed along the north side of the Charles River, and a bridge for the use of pedestrians and cyclists will be built over the commuter railroad track [see Section 3.2.6(f)]. Restoration of open space along the south bank of the Charles River also will allow for construction of a walkway/bikeway. These new facilities will link existing bicycle routes along the Charles River to the west of the project alignment with the Charlestown pier area and Navy Yard to the east.

In the Central Area, replacement of the existing Surface Artery with two separated one-way roadways will provide for safer bicycle operations. The lowering of vehicular traffic volumes on most segments of these surface roadways, and improved provisions for left-turning vehicles, will reduce conflicts between bicycle and motor vehicle operations.

The HOV system incorporated into the Proposed Action will provide for expanded and improved airport bus services. Bicycle use of the tunnels and access roads to/from Logan Airport is not permitted, but buses could be equipped to carry bicycles across the Harbor and to the airport terminals. In providing for improved bus services between South Station and the airport, the Proposed Action will create an option that allows bicycle use for travel to and from the airport.

3.3 MITIGATION MEASURES

The transportation impacts associated with the Proposed Action will be strongly beneficial in all but a few cases. On most of the affected roadway links in the study area, the project will result in reduced traffic volumes and better traffic operations, compared to the 2010 baseline. There are, nevertheless, several roadway segments on which traffic volumes will increase and operating conditions will become worse, as a result of the addition or relocation of ramps. In Section 3.2.4(a), a number of intersections were identified where project impacts will be negative in one or both peak hours. Moreover, between now and the year 2010, increased development will produce traffic growth independently of the project, which will result in greater congestion.

There is a broad range of measures that can be implemented to reduce vehicular traffic volumes and promote efficient use of available roadway capacity. The project is committed

to the implementation of a Traffic Surveillance and Control System (TSCS), which will improve operations on the Artery/Tunnel mainline above forecasted levels. This will allow the regional highway system to carry even higher percentages of study area traffic, and further reduce the traffic volumes on local streets. The TSCS is described below.

3.3.1 Traffic Surveillance And Control System (TSCS)

A TSCS system will be implemented throughout the Artery/Tunnel Project alignment to provide for continuous traffic monitoring and management. The principal elements of the system are:

- o electronic surveillance to detect incidents that cause slowdowns and blockages

- o communication systems, including variable message signs and advisory radio, to alert motorists to congestion-causing incidents

- o systematic lane control by means of displays and variable message signs

- o continuous monitoring, control, and logging of selected traffic and environmental conditions

- o communications with emergency services such as fire, police, and first aid

TSCS operations will be coordinated through a central control facility. A system of this type is recommended by the Federal Highway Administration to minimize carbon monoxide exposure to the travelling public during traffic incidents concentrations. From a traffic standpoint, the TSCS will serve to improve the quality of traffic flow and increase safety. It is estimated that the system will improve general flow characteristics and cause a major reduction in recovery time from accidents. The system will be coordinated with city roadway operations and its Traffic and Emergency Control Center (TECC).

3.3.2 Public Transportation

Public transportation is the principal means of managing the demands placed on area roadways. To promote continued growth in transit ridership, and a balanced multimodal transportation system, the MBTA has developed plans for continued expansion of capacity, introduction of new services, and implementation of operational improvements that will foster increased reliability.

The plans developed by the MBTA and other State transportation agencies have anticipated an increased need for services during the construction period for the Artery/Tunnel Project. Most of these program elements also are viewed as permanent features of the regional transportation system, since there will be continued growth in travel beyond the construction period, and a corresponding need to control the volumes of vehicular traffic on the region's highways and local roads. The principal elements of the MBTA's construction program are described below.

3.3.2(a) Rapid Transit

The MBTA's capital construction program includes a number of rapid transit elements (see Table 3.23). Many of the projects included in the program are conceived as mitigation

Table 3.23

RAPID TRANSIT IMPROVEMENTS: MBTA CAPITAL CONSTRUCTION PROGRAM

	Improvement Category					
Line	**System Expansion**	**Station/Line Relocation**	**Station Modernization Platform Lengthening**	**Equipment Acquisition**	**Operating Characteristics**	**Park and Ride**
Red	-	-	Complete	86-140 cars (1992-95)	peak 6-car (1992) 3-min. headway (1995-2000)	+13,000 (1992): 2,200-3,200 West; 6,000-7,700 South
Orange	-	-	Complete	46 cars (1992-95)	6-car (1992)[1] 3-min. headway (1995-2000)	2,600-9,300 (1992)
Green	NW to Somerville, Ball Sq (2010)	Relocate line in vicinity of North Station underground (1995) New North Station Orange/Green Lines superstation (1995) Lechmere Station (1992)	Rebuild power stations, install high-voltage cable	3-car (1992) improved headways	250 at Lechmere (1992) 800 at Woodlawn	
Blue	(1) Bowdoin-Charles (2010) (2) N to Lynn		6-car platforms Station modernization (1995)	26 cars (mid-1990s)	6-car trains (1995) 3-min. headways	

1. Six-car train operation contingent on equipment purchases
2. Numbers in parentheses represent years when project becomes operational

Source: Bechtel/Parsons Brinckerhoff

measures for the Artery/Tunnel Project; most of the elements included in the table are scheduled to be completed by the year 2000. There are two rapid transit extension projects that are in an active planning process: a northwest extension of the Green Line through Somerville is scheduled to be completed by 2010; and an extension of the Blue Line is planned from its southern terminus at Bowdoin station, to provide a connection to the Red Line at Charles station.

The MBTA's station modernization program, which has resulted in the lengthening of platforms on the Red and Orange Lines to accommodate six-car trains, will be implemented next on the Blue Line. Platforms will be extended to allow for the operation of six-car trains, providing for an increase in capacity of up to 50 percent. Six-car trains already are in operation on the Red and Orange Lines. Complete conversion to six-car train operations on these two lines will be implemented as warranted by demand.

Equipment purchases, as noted in the table, are planned for the Red and Orange Lines. Headways on all four rapid transit lines also will improve by the year 2000 which will reduce wait times for passengers and increase peak hour system capacities. The four rapid transit lines will have sufficient capacity to serve 34,140 more peak hour passengers (in each direction) than in the base year. This represents a 96 percent increase in capacity.

3.3.2(b) New Services

Three prospective new transportation services are under study; all are at the feasibility analysis stage or beyond, and several have a high probability of implementation. The three services and their status are described below.

- o Washington Street Replacement Transit Service: This project involves the operation of trackless trolleys between Dudley Square and downtown Boylston or Park Street station. Implementation is projected for 1992.

- o South Boston Piers/Fort Point Channel Transit: Public transportation alternatives are being evaluated to serve this area, in which extensive development at higher densities is anticipated. Implementation is projected by 1998. The preferred alternative for this service is a subsurface transitway that will operate in its initial phase between South Station and the Fan Pier/World Trade Center area in South Boston. Eventual extensions of the transitway are planned to connect with Boylston Street station downtown and the Boston Marine Industrial Park in South Boston. The transitway will be able to accommodate people mover, electric bus, or light rail vehicles.

- o Circumferential Transit: The feasibility of connecting various radial transit service corridors outside the CBD is being studied. Short-term bus route improvements will be implemented as conditions warrant, while analysis of long-term alternatives began recently.

3.3.2(c) Commuter Rail

Planned improvements to the commuter rail system include system expansion, station construction and upgrading, vehicle acquisition, and more frequent service. Measures involving system expansion are described below:

- o Old Colony Line Extension - This project would restore commuter rail service to the three branches (to Scituate, Middleborough, and Plymouth) of the Old Colony Railroad, which serviced southeastern Massachusetts until 1959. In its initial phase, estimated to be completed by 1992, the northern terminus of the line would be at Braintree, from where passengers would connect to downtown Boston via the Red Line. Service on the line would be extended to South Station by 1995.

- o Ipswich Line Extension to Newburyport: This project, if approved, would extend current commuter rail service between North Station and Ipswich to Newburyport. Two new stations -- one in Rowley and the other in Newburyport -- would be constructed with parking provided at both. Final design is expected in 1991, with implementation projected for late 1992.

- o Framingham Line extension to Worcester: This extension, with four new stations along its alignment, is considered possible by 1995. A feasibility study for the project is in progress.

- o New Bedford/Fall River extension.

In addition to the above service extensions, improvements are imminent at three stations on existing commuter rail lines. At North Station, a new commuter rail station will be built as a part of a redesigned multimodal transportation center. The construction of two new tracks and handicapped-accessible high platforms at North Station is scheduled to be completed by 1990. A new station is also under construction in the City of Lynn, scheduled for completion in the fall of 1990. The new Lynn station will include new commuter rail platforms, an on-street bus terminal, a 1,032-space parking garage, and retail space. At South Station, a new track will be added and one level of a public parking garage constructed, along with ramps connecting the garage to the highway system. These projects are included under Phase II of the South Station development program, scheduled for completion by 1992.

Major purchases of new commuter rail vehicles will take place over the next several years to accommodate growing demand. The MBTA will acquire 126 additional rail cars during this time period, consisting of 51 single-level coaches, delivery of which will begin in 1990, and 75 double-deck coaches, which will be delivered beginning in 1991. In addition, the delivery of between 15 and 25 new locomotives is expected by late 1990 or early 1991. These equipment purchases, along with other system improvements, will allow a reduction of peak commuter headways to 20 minutes by 1995 and 15 minutes by 2000 on all lines, whereas currently headways range from 20 to 30 minutes.

3.3.2(d) Bus

New bus terminals will be incorporated into the South Station Transportation Center and the new Lynn transit station. Most importantly from a capacity standpoint, the MBTA is purchasing 200 advanced design lift-equipped buses. These vehicles will be added to the existing bus fleet by 1990. The purchase of an additional 200 units is planned by 1992. The new bus purchases will expand peak hour fleet capacity to accommodate up to 12,000 additional passengers by 1990 and 24,000 additional passengers by 1992, in each direction, assuming average one-way trips of 0.5 hour to 1 hour. If bus trips are shorter, the capacity increase would be higher.

3.3.2(e) Transit Parking Facilities

The MBTA currently operates parking facilities with a total capacity of nearly 30,000 spaces throughout its rapid transit, bus, and commuter rail systems. Virtually all the rapid transit and commuter rail facilities are used to capacity, and there is evidence of widespread excess demand. At many stations, parking supply is the controlling factor limiting transit ridership. Substantial increases in capacity will be needed to accommodate future growth in demand.

The MBTA has developed a plan for the construction of between 15,000 and 40,000 spaces at rapid transit and commuter rail stations, under its continuing park-and-ride program. The MBTA anticipates that between 15,000 and 20,000 of these spaces will be constructed by 1995.

The total increase planned at commuter rail stations ranges from 12,960 to 29,714 spaces. Stations where major expansions of supply are anticipated include the Route 128 station on the Attleboro Line, Littleton (Route 495) and Kendall Green on the Fitchburg Line; Dedham station (new) on the Franklin Line; Greenbush station and Lakeville/Middleborough (Route 495) on the Old Colony Line; Route 3, Halifax and South Weymouth on the Plymouth branch of the Old Colony Line; West Roxbury/VFW Parkway on the Needham Line, Tyngsboro (Route 3) on the Lowell Line, and Lynn and Saugus on the Rockport Line. Most of these facilities are close to Routes 128, 495, or other regional highways, and will be able to draw on large catchment areas, with direct or nearly direct highway access.

The parking supply expansion associated with rapid transit is projected to range from 2,875 to 11,055 spaces. Increases in capacity of over 700 spaces per facility are planned for Alewife and Quincy Adams stations on the Red Line, Woodlawn station on the Green Line, and Sullivan Square and North Station on the Orange Line. All of these sites are well-situated to intercept traffic before it enters the downtown surface street network.

3.3.2(f) High-Occupancy Vehicle System

An HOV system servicing buses, taxis, limousines, vanpools, and carpools which is described in detail in Chapter 2 is an integral element of the Proposed Action. This system, which will consist of mixed HOV/local collector-distributor roads, exclusive HOV lanes, and preferential HOV access, will carry a substantial number of person trips per day. The I-93 segment of the system consisting of exclusive HOV lanes would carry over 100,000 person trips per day in the year 2010, assuming that these exclusive HOV lanes were connected to a contraflow HOV lane extending from the Massachusetts Avenue interchange to Braintree. (It should be noted that this contraflow lane is a separate project planned independently of the Proposed Action by the Department.) In the absence of the Braintree contraflow HOV lane, it is estimated that HOV use on the I-93 segment of the Proposed Action would be upwards of 60,000 person trips per day.

Further information regarding the I-93 segment of the HOV system is provided in Table 3.24. Specifically, this table shows the expected 2010 peak hour traffic volumes on the I-93 exclusive HOV lanes between South Station and Massachusetts Avenue with and without the Braintree HOV connector. Also shown are the 1987 HOV volumes on this segment of I-93 to and from areas that would be served by the I-93 HOV lanes.

As can be seen, with the Braintree HOV connector, 1,600 to 1,850 HOVs per hour would be served in the peak direction and 600 to 900 would be served in the off-peak direct in the

Table 3.24

SUMMARY OF ESTIMATED HOV VOLUMES FOR I-93 BETWEEN SOUTH STATION AND MASSACHUSETTS AVENUE

	Traffic Volumes (vehicles/hour)			
	AM Peak Hour		PM Peak Hour	
	North	South	North	South
2010 with Braintree connector	1,590	622	891	1,858
2010 w/o Braintree connector	937	622	891	1,187
1987 HOV volumes to and from areas that would be served by I-93 HOV lanes	853	498	713	1,088

year 2010. Furthermore, it can be seen that without the proposed Braintree HOV connector, the I-93 HOV lane would still carry about 60 percent of the peak direction volume and all of the off-peak direction volume in 2010.

The I-90 component of the proposed HOV system consists primarily of managed collector-distributor roads, which will carry both HOVs and local traffic, as well as exclusive HOV lanes. It is projected that the I-90 HOV component will serve at least 65,000 person trips per day.

The South Boston Bypass Road is another important component of the project's HOV system. It will carry approximately 10,000 vehicles per day and serve a mixture of HOVs and trucks. It is expected that the Bypass Road will serve at least 20,000 person trips per day. Most, if not all, of these trips are trips diverted from the I-93/I-90 Interchange area and from local streets in South Boston.

3.3.2(g) Water Transportation

The existing network of water transportation services is a product of public and private joint efforts. The MBTA currently subsidizes the Hingham-Boston (Rowes Wharf) commuter boat service, and the Massachusetts Department of Public Works provides an operating subsidy for the Charlestown-Boston (Long Wharf) ferry. In addition, the agencies of the Commonwealth have financed the construction of dock facilities and parking at several terminal sites. Continued expansion of the water transportation network generally will follow the existing model of public/private partnership.

As a part of the Artery/Tunnel Project, the Department will provide docking facilities on Lovejoy Wharf near North Station that will be available for passenger boat service. There

are several potential routes based at North Station that are likely to be attractive to private operators, including connections to Logan Airport, South Boston, Charlestown, and possibly a downtown location such as Rowes Wharf. The ferry will provide an alternative mode of transportation for trips in the heart of the study area.

A study of future water transportation services has been completed recently under the sponsorship of Massport, the Executive Office of Transportation and Construction, and the Legislative Special Commission on Marine Transit. The study recommended new services connecting the airport, the South Shore, and downtown Boston. The Commonwealth currently is considering support for this service, and is sponsoring a more detailed study of potential inner harbor services, including North Station-based routes.

3.3.3 Parking Supply Management

A potentially effective method of controlling traffic growth in downtown Boston, and possibly other nearby areas, would be implementation of more stringent restrictions on parking supply. Increased restrictions could take the form of extending the existing Boston Proper parking freeze to cover private parking and areas outside Boston Proper (e.g., South and East Boston). Modification of the parking freeze would require joint agreement by the City of Boston, the Commonwealth, and the U.S. Environmental Protection Agency.

3.3.4 Street Direction Changes

Traffic studies conducted in support of this SEIS/R show that traffic operations with the Proposed Action in place can be further improved in a number of areas by changing the direction of traffic flow on local streets in the City of Boston. The Department will work with the City to develop plans for improved vehicular circulation, including selected street direction changes.

3.4 COMPARISON WITH FEIS/R

The traffic volume and operations data presented in Section 3.2 differ considerably from comparable data contained in the FEIS/R. Three major factors account for the differences:

- o Vehicular traffic volumes have grown more rapidly than was anticipated at the time the FEIS/R was written.
- o The methodology for analyzing traffic operations has changed; procedures used in preparing the current document conform to the 1985 Highway Capacity Manual.
- o Changes in facility design will alter future traffic patterns.

The effect of unexpectedly rapid traffic growth has been to increase projected daily and peak hour traffic volumes and generally to cause a worsening of estimated traffic conditions. The second factor identified above -- methodological change -- serves to confound direct comparisons between the FEIS/R and SEIS/R. Current methods are judged by the traffic engineering profession to produce more accurate results, but it is not possible to separate the effects of the change in analysis procedure from the "true" changes related

to traffic growth or facility redesign. The following discussion therefore describes qualitatively the impacts on traffic associated with the project design modifications adopted since the FEIS/R.

Area North Of Causeway Street.

- o I-93/Leverett Circle connector ramps - changes in design have improved weaving conditions on I-93 between the Leverett Circle connectors as well as on the section between the CANA project and the Leverett Circle connector ramps.

- o Relocation of I-93 northbound on-ramp from Causeway Street to Traverse Street - results in improved traffic operations at a critical location on Causeway Street.

- o Leverett Circle eastbound underpass - provides grade separation for eastbound Storrow Drive traffic, relieving traffic congestion at Leverett Circle and deterring diversion of traffic to local streets.

Central Area.

- o Atlantic Avenue alignment of northbound Central Artery tunnel - eliminates the surface roadway planned over the FEIS/R highway tunnel in Fort Point Channel. The planned roadway would have diverted some traffic away from the Atlantic Avenue/Summer Street intersection, which would have improved traffic operations in Dewey Square, but increased traffic at the Summer Street/Dorchester Avenue intersection. The effect of eliminating the roadway is to cause traffic operations to improve at the intersection of Summer Street and Dorchester Avenue and to worsen at the Atlantic Avenue/Summer Street intersection. However, as noted in Table ____, the volumes are still _____ percent than in the best case.

- o Eliminate southbound off-ramp at Causeway Street; add southbound off-ramp at Clinton Street in Government Center area - the addition of the Clinton Street off-ramp removes traffic from the Surface Artery in the Haymarket area, while elimination of the Causeway Street off-ramp alleviates a weaving section south of the Leverett Circle connectors. The combination of these two design changes has a beneficial effect on mainline and surface street traffic operations, with a slight increase in southbound volume on the Surface Artery south of the Clinton Street ramp.

- o Southbound on-ramp in Government Center area moved from New Sudbury Street to New Chardon Street - alleviates the weaving problem between the on-ramp and the Oliver Street off-ramp in the Financial District.

- o Relocation of Southbound Callahan Tunnel on-ramp from North Street to New Chardon Street - eliminates adverse impact on the congested North Street/Surface Artery intersection.

I-90/I-93 And I-93/Massachusetts Avenue Interchange Area.

- o I-93/I-90 Connector - The FEIS/R design included a ramp providing a direct south-to-west move. The SEIS/R design combines this move with others in a common

nested loop move, which alleviates a major weave problem on interstate-to-interstate ramp movements.

- o Two-way Herald Street local roadway connection replaced by one-way Herald Street/Marginal Road couplet - This action alleviates traffic problems on Broadway, Frontage Road, the Broadway/Herald Street intersection, and Albany Street.

- o I-93/Massachusetts Avenue intersection - Two-way connector roads were added to the project since the FEIS/R. These connector roads link the Frontage roads with the Massachusetts Avenue connector and the South Boston Bypass Road. The resulting roadway system allows removal of a high-speed left lane off-ramp and a left lane on-ramp on I-93, which interfere with mainline traffic flow.

South Boston.

- o Replacement of a single I-90 service road connection to Northern Avenue with a pair of service roads - The FEIS/R design included a two-way connection between the Seaport Access Road and Northern Avenue on a single roadway, which created serious traffic problems at the intersection of the roadway with both Congress Street and Northern Avenue. The SEIS/R design provides for a pair of service roads, with traffic on the westerly service road crossing under Congress Street. This design modification improves traffic operations, particularly at the Congress Street intersection.

- o South Boston Bypass Road - A bypass road was added to the project since the FEIS/R, the principal benefits of which are to remove truck traffic from local streets in South Boston, and reduce traffic in the I-93/I-90 Interchange. In addition, the bypass road serves as a major link in the project's HOV system, which serves as an incentive to HOV use and reduces automobile traffic.

East Boston.

- o The 1985 FEIS/R design called for a new northbound connector ramp from I-90 to Route 1-A near the Delta reservation center, creating a weave problem between the on-ramp and the Neptune Road off-ramp. A fly-under connection between Logan Airport and Route 1A northbound, beyond the Neptune Road exit, was added to the project since the FEIS/R. This design modification removes traffic originating at the airport from a difficult weaving section, reducing the congestion associated with this weave.

- o Relocation of I-90 toll booths from South Boston downstream of the westbound Third Harbor Tunnel exit, to East Boston upstream of the tunnel entrance - toll booth relocation will substantially improve safety and traffic flow through the tunnel and at its approach and exit. Detailed operational characteristics of this change are described in Volume 2 of this SEIS/R.

3.5 RESOLUTION OF ISSUES RAISED BY AGENCIES

Numerous comments were received on the Transportation section of the Cooperating Agency Draft. These comments can be grouped into several categories:

- o Additional detail/analysis required
- o Corrections to factual information or terminology
- o Corrections to table/figure numbering or labeling of information in tables
- o Criticisms of policy/design

With respect to the first category identified above, judgement has been exercised regarding the appropriateness of increasing the level of detail presented in the SEIS/R, particularly in view of the need to limit the volume of material incorporated in the main SEIS/R document. The additions and changes in analysis incorporated in this chapter, at the request of the agencies, are as follows. The analysis of traffic entering and leaving the core of the study area has been changed to eliminate double-counting, and a new screenline analysis has been added to document changes in local traffic circulation. Traffic operations have been analyzed at several additional intersections considered critical by the City of Boston. Operating speeds have been revised to account for the effects of converging traffic streams and lane reductions. Graphics have been added to show the locations of all roadway segments and intersections for which data are reported. Also, some of the additional information requested has been included in the Transportation Appendix.

All the suggested corrections of fact and terminology were evaluated, and most were incorporated into the text. The format of the text, including the sequence of tables and figures, generally has been changed in the new draft, such that the agencies' corrections are not applicable. There are several instances, however, in which table formats and labeling have been revised. Finally, all questions of policy or project design have been reviewed by the Department, and the current text reflects the resolution of these issues.

Chapter 4 – Air Quality

Chapter 4
AIR QUALITY

This chapter describes the results of the analysis of the air quality impacts associated with the operation of the Artery/Tunnel Project. An assessment of the construction-related air quality impacts of the project is provided in Chapter 20. Included is a description of existing (1987) conditions, estimates of in-tunnel air quality concentrations, an analysis of the regionwide impact of the Artery/Tunnel Project (mesoscale analysis), an investigation of the impact of the project on carbon monoxide levels at critical locations within neighborhoods along the proposed alignment (microscale analysis) and near proposed toll facilities, and an analysis of impacts associated with proposed tunnel ventilation systems. Air quality levels with the project are compared with future conditions without the project, and with applicable National and State Ambient Air Quality Standards and guidelines. Analyses were conducted for 1998, the estimated year of project completion, and 2010, the project design year.

Also provided is a summary of the process used to select the locations of project ventilation buildings. Their location is one of the issues identified by the reviewing agencies as needing further investigation in the design phase.

The chapter closes with a comparison of the results of this air quality analysis with the results of the air quality analysis included in the FEIS/R, a discussion of the conformance of the project with the approved Massachusetts plan implementing the requirements of the Clean Air Act (State Implementation Plan), and a summary of the air quality-related issues identified by public agencies.

The results of this analysis indicate that, in general, the Artery/Tunnel Project will result in beneficial effects on air quality. While it is estimated that emissions will increase at a few locations along the project alignment due to increased traffic and projected changes in travel patterns, these are favorably offset by overall decreases in emissions resulting from improved traffic flow and the elimination of roadway bottlenecks.

4.1 AIR POLLUTANTS

Seven air pollutants have been identified by the U.S. Environmental Protection Agency (EPA) as being of concern nationwide: carbon monoxide, hydrocarbons, nitrogen oxides, ozone, particulate matter, sulfur oxides, and lead.

Carbon Monoxide. Carbon monoxide (CO) is a colorless and odorless gas which is generated in the urban environment primarily by the incomplete combustion of fossil fuels in motor vehicles. Relatively high concentrations of CO are typically found near crowded intersections and along heavily used roadways carrying slow-moving traffic. CO chemically combines with the hemoglobin in the red blood cells to decrease the oxygen-carrying capacity of the blood. Prolonged exposure can cause headaches, drowsiness, or loss of equilibrium.

Hydrocarbons. Hydrocarbons (HC) include a wide variety of organic compounds emitted principally from the storage, handling, and use of fossil fuels. Though HC can cause eye

irritation and breathing difficulty, their principal health effects are related to their role in the formation of ozone.

Nitrogen Oxides. Nitrogen oxides (NO_x) constitute a class of compounds that includes nitrogen dioxide (NO_2) and nitric oxide (NO), both of which are emitted by motor vehicles. Although NO_2 and NO can irritate the eyes and nose and impair the respiratory system, NO_x is of concern primarily because of its role in the formation of ozone.

Ozone. Ozone (O_3), or photochemical oxidants, is a principal cause of lung and eye irritation in an urban environment. It is formed through a series of reactions involving HC and NO_x which take place in the atmosphere in the presence of sunlight. Relatively high concentrations of O_3 are normally found only in the summer.

Particulate Matter. Particulate matter includes both liquid and solid particles of a wide range of sizes and composition. Of particular health concern are those particles which are smaller than or equal to 10 microns (PM_{10}) in size (one micron equals 0.000001 meter). The principal health effects of airborne particulate matter are on the respiratory system. Relatively little particulate matter is emitted by motor vehicles.

Sulfur Oxides. Sulfur oxides (SO_x) constitute a class of compounds of which sulfur dioxide (SO_2) and sulfur trioxide (SO_3) are of greatest importance. Relatively little SO_x is emitted from motor vehicles. The health effects of SO_x include respiratory illness, damage to the respiratory tract, and bronchioconstriction.

Lead. Lead is a stable element which persists and accumulates both in the environment and in animals. Its principal effects in humans are on the blood-forming, nervous, and renal systems. Motor vehicles constitute the major source of lead emissions to the atmosphere. Lead levels in the urban environment are decreasing as a result of its elimination from gasoline.

4.2 AIR QUALITY STANDARDS AND REGULATIONS

4.2.1 National And State Ambient Air Quality Standards

As required by the Federal Clean Air Act Amendments of 1970 (P.L. 91-604, December 31, 1970) and the Clean Air Act Amendments of 1977 (P.L. 95-95, August 7, 1977), primary and secondary National Ambient Air Quality Standards (AAQS) have been established for the following air pollutants: CO, NO_2, O_3, PM_{10}, SO_2, and lead (see Table 4.1). These standards have been officially adopted as the Massachusetts State ambient air quality standards. The "primary" standards have been established to protect public health. The "secondary" standards are intended to protect the nation's welfare and account for the effects of air pollutants on soil, water, visibility, materials, vegetation, and other aspects of the general welfare.

4.2.2 Massachusetts NO_2 Policy Level

The Massachusetts Department of Environmental Protection (DEP) also established a site-specific short-term (1-hour) "policy level" for NO_2 of 320 micrograms per cubic

Table 4.1

NATIONAL AND STATE AMBIENT AIR QUALITY STANDARDS
(micrograms per cubic meter)

		Standard			
Contaminant	**Averaging Period**	**Primary**		**Secondary**	
Carbon Monoxide (CO)	8-hour[1]	10,000	(9.0 ppm)	10,000	
	1-hour[1]	40,000	(35.0 ppm)	40,000	
Sulfur Dioxide (SO_2)	Annual	80	(0.03 ppm)		
	24-hour[1]	365	(0.14 ppm)		
	3-hour[1]			1,300	(0.5 ppm)
Nitrogen Dioxide (NO_2)[2]	Annual	100	(0.05 ppm)	100	
Ozone (O_3)	1-hour[1]	240	(0.12 ppm)	240	
PM_{10}	Annual	50		50	
	24-hour[1]	150		150	
Lead (Pb)	3-month	1.5		1.5	

1. Not to be exceeded more than once a year per site
2. The Massachusetts Department of Environmental Protection has established a 1-hour guideline level of 320 ug/m^3 for NO_2, with a corresponding significant impact level of 32 ug/m^3

Sources: EPA, National Primary and Secondary Ambient Air Quality Standards (40 CFR 50)

Massachusetts DEP, Massachusetts Ambient Air Quality Standards (Title 310), April 20, 1978

meter (ug/m^3) (DEP, April 20, 1978). A source is considered to have a "significant impact" under this policy guideline if it is estimated to cause an increase in 1-hour NO_2 levels of 10 percent or more of the policy guideline, i.e., 32 ug/m^3.

4.2.3 Toxic Pollutants In Vehicular Exhaust

In addition to the pollutants for which National and Massachusetts AAQS have been established, extremely small quantities of a wide range of the air pollutants are emitted by motor vehicles, some of which can be characterized as air toxics; Table 4.2 lists the carcinogenic (cancer-causing) and non-carcinogenic toxic substances for which human exposure criteria have been established by either EPA or Massachusetts DEP.

Air toxics are pollutants in the atmosphere that can increase the risk of cancer to exposed individuals and/or cause adverse chronic health effects within the general population exposed to the pollutants. Air toxics are generally emitted in trace amounts and can be either primary pollutants (i.e., emitted directly from a source) or secondary pollutants (i.e., compounds formed by the chemical transformations of primary pollutants in the atmosphere). Pollutants may be emitted either as a gas, or as a solid or liquid particle. Gaseous pollutants may be directly inhaled or be subsequently transformed through chemical reaction or absorption into a liquid or solid particle. These changes may affect the toxicity of the original pollutant.

Organisms may take up toxic pollutants through three pathways: inhalation, ingestion of compounds deposited on food, water or soil, and absorption through the skin. The toxicity and amount of the pollutant taken up through each pathway varies significantly. Generally, the contribution of each of the three pathways to the total incremental risk to an individual or population differs by pollutant. Some air toxics are not carcinogenic and, consequently, have a threshold concentration below which no acute or chronic impact will occur. Some carcinogens are emitted in such small quantities that their relative contribution to the total risk of cancer is insignificant.

Based on a comprehensive review of the literature regarding the emission of non-criteria pollutants emitted during operation of gasoline- and diesel-powered vehicles, it has been determined that the concentration of non-criteria compounds found in gasoline and diesel fuels, and the amount of these compounds which are emitted from motor vehicles, are a function of vehicle type, vehicle speed, vehicle operating conditions, vehicle age, ambient temperature, and the type, composition, and vapor pressure of the fuel. The literature review indicated that the studies on the emissions of non-criteria pollutants from gasoline- and diesel-powered engines were performed for a variety of reasons, and that no two studies were exactly alike. As a result, it is concluded that there is a substantial amount of uncertainty as to the emissions data, since the data were compiled using varying sampling and analytical methods, sampling times, site type definitions, and quality control procedures.

Information on the emission characteristics of gasoline- and diesel-powered engines are available from two major types of studies: dynamometer studies and ambient air measurements. Dynamometer studies are tests performed in a laboratory under controlled conditions. Although such tests may cover a wide range of vehicle types and fuels, operation of the vehicles during these tests typically follow standard EPA driving cycles,

Table 4.2

AIR TOXICS IDENTIFIED IN VEHICLE EXHAUST

	Substance
	Non-Carcinogenic[1]
Particulate and aerosol	Lead
	Nickel
	Chromium (metal)
	Sulfuric acid
	Ammonia
Gases	Toluene
	Xylene
	Hydrogen cyanide
	Acetone
	Cyclohexane
	Ethylbenzene
	Hexane
	Potentially Carcinogenic[1]
Particulates	2,3,7,8-TCDD
	Benzo(a)pyrene
	Asbestos
Gases	1,3-Butadiene
	Formaldehyde
	Benzene
	Acetaldehyde
	Ethylene

1. Carcinogenic and non-carcinogenic toxic substances for which human exposure criteria have been established by EPA or Massachusetts DEP

Source: ENSR 1990

and may not reflect everyday driving habits and equipment maintenance conditions pertinent to the Boston region. Ambient measurements include samples of air usually taken downwind, and, less frequently, upwind of various roadways, busy highways, and tunnels. As such, the data from these studies reflect site-specific factors such as vehicle speed and vehicle mix that cannot be easily generalized to other situations. Existing ambient levels of these compounds in Boston have not been reliably established through long-term sampling at a network of air pollutant monitors, similar to those in place to monitor pollutants for which National and Massachusetts AAQS have been promulgated.

Practical and effective methods for the control of these compounds are currently not available. Currently available controls are limited to those for the removal of relatively high concentrations of these pollutants found in gaseous effluents from industrial processes. These methods generally require operating temperatures and pressures far in excess of those which could reasonably be applied to the removal of pollutants from motor vehicle exhaust, particularly the very diluted and low pressure and temperature gas streams emitted from project ventilation buildings.

The levels of these substances in the atmosphere, their potential health risk, and methods for their control are currently under study by experts throughout the country. Detailed microscale modeling of these substances to estimate current emission rates and their impact on ambient levels or any potential impacts in connection with the Artery/Tunnel Project cannot currently be completed with a satisfactory degree of certainty, given the lack of information on the characteristics of motor vehicle exhaust emissions for specific toxic compounds. However a much more reliable indicator of future trends on volatile organic compounds (VOC) is total non-methane hydrocarbons (HC), and an analysis of hydrocarbons in the context of the Artery/Tunnel Project was performed as part of this document.

4.3 POLLUTANTS FOR ANALYSIS

Of relevance to evaluating the impact of the Artery/Tunnel Project are those pollutants that can be traced principally, or in large measure, to motor vehicles. These include CO, HC, NO_x, O_3, and lead. Transportation sources account for a very small percentage of regional emissions of particulate matter and SO_x, and detailed analyses for these contaminants are not warranted.

Although motor vehicles have historically constituted a major source of lead emissions to the atmosphere, lead levels have decreased significantly and will continue to do so, due to the mandated decrease and elimination of lead in gasoline. Therefore, a detailed analysis of the impact of lead emissions is also not warranted.

CO impacts are localized; even under the worst meteorological conditions and most congested traffic conditions, high concentrations are limited to within a relatively short distance (300 to 600 feet) of heavily travelled roadways. Consequently, it is appropriate to predict concentrations of CO on a localized or "microscale" basis. CO impacts from vehicular exhaust passing through the project ventilation system are also evaluated.

HC and NO_x are reactive pollutants whose impacts occur relatively far from their source. As they disperse downwind, these pollutants react slowly in the presence of

sunlight to form O_3. This formation ordinarily takes place some distance from the sites from where HC and NO_x were emitted. Consequently, the effects of these pollutants on the formation of O_3 generally are examined on an areawide or "mesoscale" basis. In addition, the localized short-term (1-hour) impacts of NO_2 from the ventilation building emissions were evaluated to show compliance with DEP's guideline level.

Based on these considerations, CO concentrations were estimated using a detailed microscale mobile source impact analysis, a detailed ventilation system impact analysis, and a regional (mesoscale) basis. NO_x and HC were analyzed on a mesoscale basis to assess their potential effect on O_3. NO_2 emissions from proposed ventilation buildings were analyzed on a microscale basis to permit direct comparison with the 1-hour DEP site-specific policy level and the annual AAQS for NO_2.

4.4 AFFECTED ENVIRONMENT: EXISTING AIR QUALITY

DEP and EPA recommend that assessments of the air quality impacts of proposed highway projects be based on the most recently available 3 years of ambient air quality monitoring data representative of the project area. The FEIS/R was based on monitoring data for the period 1980 to 1982. The description of ambient air quality provided below updates this information on the basis of monitoring data for the period 1985 to 1987, the most recent 3-year period for which ambient air quality data were available. Recorded levels are compared with National and Massachusetts AAQS, including the AAQS for fine particulate matter (PM_{10}), which was established since the FEIS/R. NO_2 levels also are compared with the DEP NO_2 site-specific policy level.

Six pollutants (SO_2, CO, O_3, NO_2, lead, and particulate matter) are routinely monitored by DEP. Provided below is a summary of monitored levels of O_3, NO_2, and CO for the period 1985 to 1987, a comparison of monitored levels with applicable National and Massachusetts AAQS and the DEP NO_2 policy level, the results of a microscale air quality dispersion modeling analysis to estimate existing (1987) CO levels in the vicinity of the project alignment, and the results of a mesoscale analysis to estimate existing (1987) daily and annual burdens of CO, HC, and NO_x emissions in the affected neighborhoods.

4.4.1 Monitored Levels

4.4.1(a) Ozone

Table 4.3 provides a summary of the maximum 1-hour O_3 concentrations recorded at monitoring stations in the Boston region during 1986 and 1987. Concentrations in excess of the standard were recorded at stations in Chelsea and Sudbury, the closest monitoring stations to the project area.

4.4.1(b) Nitrogen Dioxide

NO_2 levels were monitored at three locations in the Boston region (340 Bremen Street in East Boston, Kenmore Square in Boston, and Chelsea) in 1985, 1986, and 1987. Maximum 1-hour and annual mean concentrations of NO_2 recorded at these sites are provided in Table 4.4. The State and National AAQS for NO_2 were not exceeded at any of these stations. Maximum 1-hour NO_2 concentrations were greater than the DEP NO_2

Table 4.3

MAXIMUM AND SECOND-HIGHEST HOURLY OZONE CONCENTRATIONS MEASURED IN THE BOSTON METROPOLITAN AREA (ppm)

Site	Year	Highest Concentration	Second Highest Concentration	Number of Days 1-Hour AAQS Was Exceeded[1]
Chelsea	1986	0.125	0.123	1
	1987	0.126	0.116	0
Sudbury	1986	0.100	0.090	0
	1987	0.143	0.138	4

1. Violations of the AAQS occur if hourly standard is exceeded on more than 1 day of the monitoring year

Source: Air Quality Data Reports for 1986 and 1989, Commonwealth of Massachusetts Department of Environmental Protection: Division of Air Quality Control

Table 4.4

ANNUAL MEAN, MAXIMUM HOURLY, AND SECOND-HIGHEST HOURLY NO_2 CONCENTRATIONS MEASURED IN THE BOSTON METROPOLITAN AREA (ug/m^3)

Site	Year	Highest 1-Hour[1]	Second-Highest 1-Hour[1]	Annual Mean[2]
Kenmore Square	1985	301	228	75
	1986	397	361	62
	1987	323	323	72
340 Bremen Street	1985	213	196	57
	1986	376	301	64
	1987	220	220	64
Chelsea (Powder Horn Hill)	1985	216	184	45
	1986	273	241	45
	1987	203	197	45

1. DEP 1-hour NO_2 policy guideline equals 320 ug/m^3
2. Annual AAQS equal 100 ug/m^3

Source: Air Quality Data Reports for 1985, 1986, and 1987, Commonwealth of Massachusetts Department of Environmental Protection, Division of Air Quality Control

policy level in 1986 and 1987 at the Kenmore Square monitoring station, and in 1986 at the Bremen Street monitoring station.

4.4.1(c) Carbon Monoxide

Four CO monitoring stations were operated by DEP in Boston in 1985, 1986, and 1987 (Kenmore Square, Kneeland Street, 340 Bremen Street, and Washington Street). In 1987, the Kneeland Street station was closed and a new monitoring station near the Callahan Tunnel in East Boston (Visconti Street) was opened. Maximum 1-hour and 8-hour concentrations recorded at these stations in 1985, 1986, and 1987 are presented in Table 4.5. No violation of the 1-hour national AAQS of 35 ppm was reported at any station during 1985, 1986, and 1987; the highest 1-hour concentration, 29 ppm, was reported at Washington Street. Violations of the 8-hour CO AAQS of 9 ppm were recorded at Washington Street in 1985.

4.4.2 Existing (1987) Carbon Monoxide Levels In The Project Area Estimated Based On Microscale Modeling

Microscale air quality modeling was performed using the most recent version of the EPA mobile source emission factor model (MOBILE 4) and the CAL3QHC air quality dispersion model to estimate existing (1987) CO levels in the project area. Estimates were completed for 39 locations in the vicinity of the project alignment.

4.4.2(a) Description Of The CAL3QHC Model

The CAL3QHC air quality dispersion model is a modification of the CALINE 3 model (CALINE 3: A Versatile Dispersion Model for Predicting Air Pollutant Levels Near Highways and Arterial Streets, Report Number FHWA/CA/TL-79/23). CALINE 3 is a mainframe computer-based air quality dispersion model developed by the California Department of Transportation. The model estimates air pollutant concentrations downwind of a roadway based on the assumptions that pollutants emitted from motor vehicles travelling along a segment of roadway can be represented as a "line source" of emissions, and that pollutants will disperse in a Gaussian or "normal" distribution from a defined "mixing zone" over the roadway being modeled. The rate at which pollutants disperse is assumed to be a function of wind speed and direction, and the temperature profile of the atmosphere The model assumes that the rate at which pollutants will disperse downwind from a source is directly proportional to wind speed, and that the rate at which pollutants will disperse laterally and vertically from the nominal direction of the wind is proportional to the stability of the atmosphere, and the total height in the atmosphere ("mixing height") to which pollutants will rise. "Unstable" atmospheric conditions and high mixing heights, resulting from large vertical temperature gradients in the atmosphere, will generally result in increased dispersion of air pollutants. "Neutral" atmospheric conditions (indicated by little variation in the vertical temperature profile of the atmosphere), and relatively low mixing heights will generally result in reduced dispersion of pollutants.

Principal inputs to the CALINE 3 Model include:

- o The geometry of the roadway being evaluated, including its length, height, width, and number and location of lanes
- o The locations of the sites for which air quality estimates are being completed (i.e., receptor locations)

Table 4.5

MAXIMUM AND SECOND-HIGHEST 1-HOUR AND 8-HOUR CO CONCENTRATIONS MEASURED IN THE BOSTON METROPOLITAN AREA (ppm)

Site	Year	Highest 1-Hour	Second-Highest 1-Hour[1]	Highest 8-Hour	Second-Highest 8-Hour[2]	Number of 8-Hour Averages > AAQS
Kenmore Square	1985	13	10	9	7	0
	1986	12	12	7	7	0
	1987	14	13	10	7	1
Kneeland Street[3]	1985	8	8	6	5	0
	1986	6	6	5	5	-
340 Bremen Street	1985	29	9	6	6	0
	1986	9	8	7	6	0
	1987	17	14	11	6	1
Washington Street	1985	17	16	10	9	1
	1986	25	18	12	12	3
	1987	13	13	8	8	0
Visconti Street[4]/ Callahan Tunnel	1987	12	12	7	6	-

1. CO 1-hour AAQS equal 35 ppm
2. CO 8-hour AAQS equal 9 ppm
3. Monitor discontinued in 1986
4. Monitor started up in 1987

Source: Air Quality Data Reports for 1985, 1986, and 1987, Commonwealth of Massachusetts Department of Environmental Protection, Division of Air Quality Control

- o An estimate of the rate of emissions for each pollutant for which estimates are being completed

- o Assumed meteorological conditions, including wind speed, wind direction, atmospheric stability class, temperature, and mixing height

The principal output from the model is an estimate of pollutant concentrations at each receptor location for which estimates are being completed. Given source strength, meteorology, site geometry, and site characteristics, the CALINE 3 model can reliably predict pollutant concentrations for receptors located within 150 meters of a roadway. The model is limited to the prediction of the concentration of inert (non-reactive) pollutants, including CO.

The CALINE 3 model was modified by Regions I and IV of the EPA to calculate CO concentrations in the vicinity of congested intersections. The resulting model, CAL3Q, is a consolidation of a Connecticut Department of Transportation motor vehicle queuing model based on the Webster Formula (which estimates the number of vehicles that will idle at an intersection) and CALINE 3. CAL3Q was developed to approximate the methods used in the Untied States Environmental Protection Agency guidelines for estimating air quality impacts in the vicinity of "indirect sources" of air pollution (EPA, "Guideline for Air Quality Maintenance Planning and Analysis, Volume 9 (Revised): Evaluating Indirect Sources, September 1978). (An indirect source of air pollution is a facility, building, structure, or installation, including roadways, which attract mobile sources of carbon monoxide emissions.)

CAL3QHC is a further modification of the CAL3Q model. Specifically, CAL3Q was modified to permit its use on a personal computer, and the input to the program was modified to permit the analysis of various ranges of wind direction. In addition, the queuing portion of the CAL3Q model was modified to be consistent with the queuing methodology provided in the most recent version of the Highway Capacity Manual (Transportation Research Board, "Highway Capacity Manual" Special Report 209, National Research Council, Washington, DC, 1985). This was accomplished by substituting the formula for estimating queue length provided in the 1985 Highway Capacity Manual for the Webster formula for predicting queue length found in the CAL3Q model. (A complete description of the CAL3QHC model can be found in "User's Guide to CAL3QHC -- A Modeling Methodology for Predicting Pollutant Concentrations Near Roadway Intersections," U.S. Environmental Protection Agency, Technical Support Division, Triangle Research Park, North Carolina, April 1990.)

CAL3QHC has undergone extensive testing by EPA and has been found to provide reliable estimates of inert (non-reactive) pollutant concentrations resulting from emissions from motor vehicles. EPA and DEP have approved the use of the CAL3QHC model for the analysis of the operational-related impacts of the Artery/Tunnel Project.

4.4.2(b) Receptor Locations
CO levels resulting from motor vehicles using the Artery/Tunnel Project and associated roadways were estimated at 39 locations using the CAL3QHC model (see Figure 4.1). Figures 4.2(a) and (b) show analysis sites near the existing and proposed toll plazas in East Boston. Sites were selected on the basis of existing and estimated future traffic conditions, and included the locations where the greatest project-related air quality impacts could occur. Sites also included sensitive receptors along the project alignment

Note: See Table 4.8 for list of analysis sites.

FIGURE 4.1

Location Of Mobile Source Air Quality Analysis Sites

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

0 800 1600 2400 3200 Feet

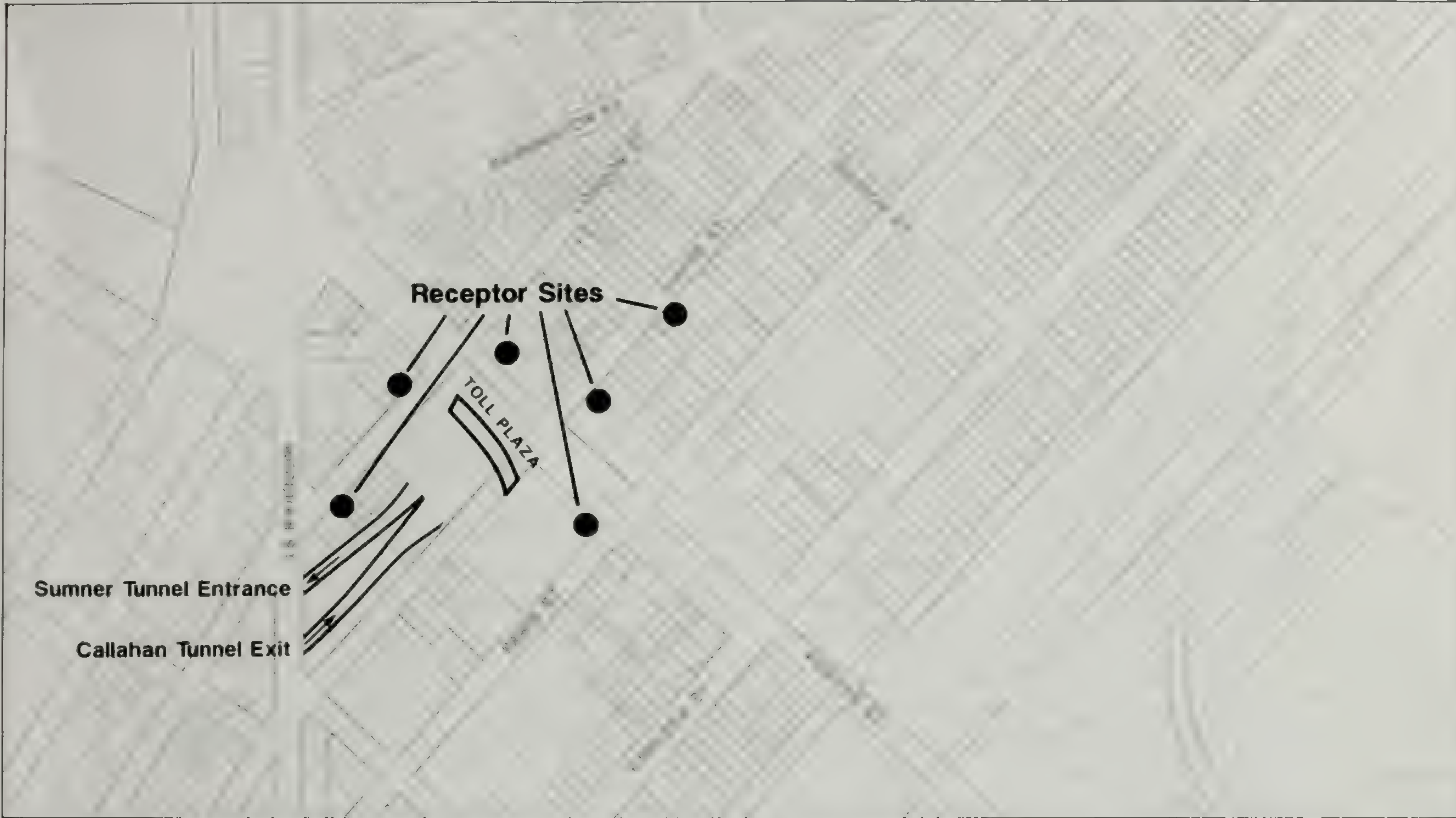

FIGURE 4.2 (a) **Mobile Source Receptor Analysis Sites - East Boston Toll Plaza**

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

0 100 200 400 Feet

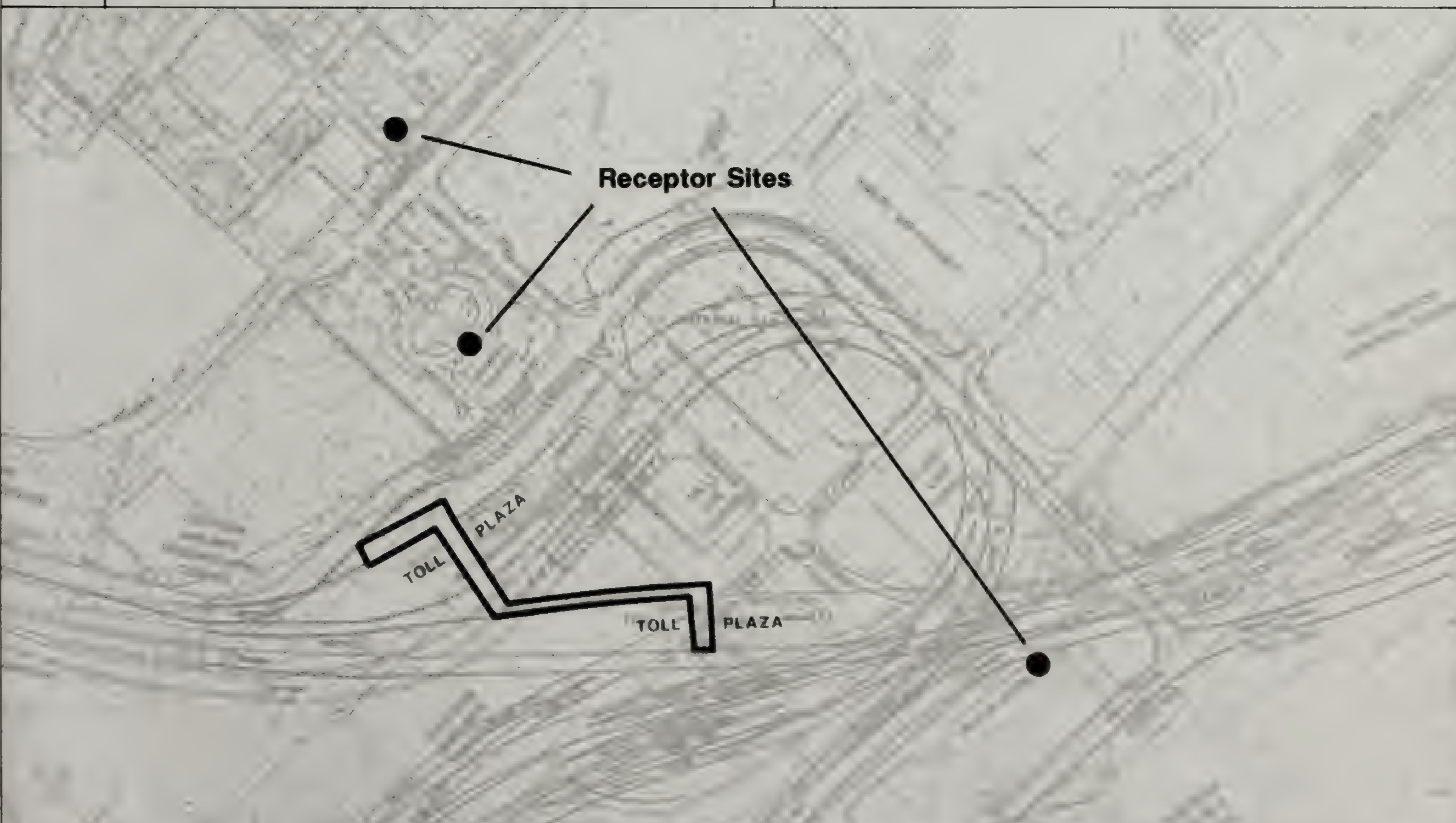

FIGURE 4.2 (b) **Mobile Source Receptor Analysis Sites - East Boston Toll Plaza**

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

0 200 400 800 Feet

such as residences, schools, and hospitals, and to geographically represent all potentially affected areas along the project alignment. Estimates were completed for corner and midblock locations in the vicinity of each nominal prediction site.

4.4.2(c) Meteorological Conditions

The transport and concentration of pollutants emitted from motor vehicles are influenced by three principal meteorological factors: wind direction, wind speed, and the temperature profile of the atmosphere. In applying the CAL3QHC model, values for these parameters were chosen to maximize pollutant concentrations at each prediction site (i.e., to establish a reasonable "worst case" situation).

In terms of wind direction, maximum CO concentrations are normally found when the wind is assumed to blow approximately parallel to the roadway adjacent to the receptor location. At each receptor location, the approximate wind angle that would result in maximum pollutant concentrations was used in the analysis regardless of actual frequency of occurrence.

In terms of wind speed, CO concentrations are greatest at low wind speeds. A wind speed of 1 meter per second was used to predict CO concentrations during peak traffic periods.

In terms of the temperature profile of the atmosphere, maximum CO concentrations occur when the temperature is low, when the height in the atmosphere ("mixing height") to which pollutants will rise is low, and when there is little variation between the temperature found at ground level and the temperature found at elevated heights in the atmosphere ("neutral" atmospheric conditions). An ambient temperature of 30°F, a "mixing" height of 1,000 meters, and "neutral" atmospheric stability conditions were used in estimating microscale CO concentrations.

CO estimates which result from assuming the simultaneous occurrence of low wind speeds, low atmospheric temperature, low vertical "mixing" height, "neutral" atmospheric conditions, and a wind direction approximately parallel to the roadway being evaluated, will generally be the maximum concentrations which could be expected to occur at each air quality receptor site analyzed.

4.4.2(d) Vehicular Emissions

Air pollutant emissions were estimated using the most recent version of EPA's Mobile Source Emissions Model, MOBILE 4 (User's Guide to MOBILE 4: Mobile Source Emission Factor Model, Publication No. EPA-AA-TEB-89-01, Ann Arbor, Michigan, February 1989).

MOBILE 4 is a recent update of MOBILE 3 (User's Guide to MOBILE 3, Mobile Source Emissions Model, Publication No. EPA-460/3-84-002, Ann Arbor, Michigan, June 1984). Estimated emissions for future years using MOBILE 4 are generally lower than emissions estimates using MOBILE 3 for virtually all vehicle types, vehicle speeds, and vehicle operating conditions. Lower emission factors in MOBILE 4 are attributed to the wider use of multiport fuel injection systems in future years and are based on a multiyear comprehensive vehicle emissions testing program completed by EPA to update vehicle emission factors estimated through MOBILE 3.

Total emissions are affected by the type of vehicles using the facility. The percentages of each type of vehicle were based on data from traffic counts taken within different affected

neighborhoods, supplemented with national averages to establish the relative proportion of gasoline- and diesel-powered vehicles.

Emission estimates account for three possible vehicle operation conditions: cold-vehicle operation, hot-start operation, and hot-stabilized operation. CO emissions are greatest when engines are cold (cold-vehicle operation) and when engines are restarted shortly after they were shut off (hot-start operation). Vehicular operating conditions used in this analysis are summarized in Table 4.6.

Emission estimates were based on implementation of the Massachusetts automobile and light-duty gasoline-powered truck inspection and maintenance (I&M) program, which began in 1983. The I&M program requires that automobiles and light-duty trucks be inspected annually to determine if CO and HC emissions from the vehicles are below strict emission standards. Vehicles failing the emissions test must undergo maintenance and pass a retest in order to be registered.

4.4.2(e) Traffic Data

Traffic data for the air quality analysis were derived from traffic counts, speed data, and other information developed as a part of the traffic analysis for the SEIS/R. The microscale CO analysis was based on estimates of traffic conditions during the peak 8-hour traffic period (10 AM to 6 PM). This is the period when the greatest traffic volumes and highest air quality levels would be expected to occur.

4.4.2(f) Persistence Factor

Peak 1-hour concentrations of CO were obtained by dividing peak 8-hour CO estimates by 0.7. This factor accounts for the fact that vehicle volumes, vehicle speeds, and meteorological conditions over 8 hours will vary from those which will persist for only 1 hour.

4.4.2(g) Background Concentrations

Microscale modeling is used to predict CO concentrations resulting from emissions from motor vehicles using roadways immediately adjacent to the location at which predictions are being made. A "background" level must be added to this value to account for CO entering the area from other sources upwind of the location at which predictions are being made.

CO background concentrations used in this analysis are presented in Table 4.7. These values were developed in consultation with EPA and Massachusetts DEP, on the basis of second-highest 8-hour and 1-hour levels of CO recorded at DEP monitoring stations.

4.4.2(h) Carbon Monoxide Levels In 1987

The results of this analysis, summarized in Table 4.8, indicate that peak 1-hour CO levels are less than (comply with) the 1-hour AAQS at all locations analyzed, but that peak 8-hour concentrations of CO are greater than (do not comply with) the 8-hour AAQS at the majority of locations analyzed. This is consistent with recorded CO levels in the Boston region, and with the fact that EPA has established that the Boston region is not attaining the 8-hour CO AAQS.

4.4.3 Estimated Areawide Pollutant Emissions In 1987 (Mesoscale Analysis)

The Proposed Action would affect (and as described below will substantially reduce) the total quantities of motor vehicle-related pollutants emitted in the Boston region. These

Table 4.6

VEHICULAR OPERATING CONDITIONS

Operating Condition	**Percentage On Local Streets**	**Percentage On Central Artery Roadways and Exit Ramps**
Cold (Non-Catalyst)	15.0	5.0
Hot-Start (Catalyst)	20.0	5.0
Cold (Catalyst)	15.0	5.0

Source: EPA Region I and Massachusetts DEP

Table 4.7

CARBON MONOXIDE BACKGROUND LEVELS
(ppm)

	1987	1998		2010	
		Without The Project	**With The Project**	**Without The Project**	**With The Project**
1-Hour Average	5.0	3.0	2.9	3.1	3.0
8-Hour Average	3.0	1.8	1.8	1.8	1.8

Source: Bechtel/Parsons Brinckerhoff

Table 4.8

ESTIMATED 1-HOUR AND 8-HOUR WORST CASE CARBON MONOXIDE LEVELS IN 1987 BASED ON MICROSCALE MODELING (ppm)

Analysis Site		1-Hour Average		8-Hour Average	
No.	Location	Corner	Midblock	Corner	Midblock
1	Charlestown Avenue and O'Brien Highway	21.1	17.6	14.3	11.8
2	City Square	10.0	8.4	6.5	5.4
3	Leverett Circle	19.7	15.3	13.3	10.2
4	Causeway/Merrimac/Lomasney	15.0	10.1	10.0	6.6
5	Causeway and Haverhill Streets	12.9	11.1	8.5	7.3
6	Causeway and Beverly Streets	12.7	11.0	8.4	7.2
7	North Washington and Commercial Streets	23.3	12.9	15.8	8.5
8	New Sudbury and Congress Streets	21.0	12.0	14.2	7.9
9	New Chardon/Haverhill/North Washington	10.0	10.0	6.5	6.5
10	New Chardon/Stillman/North Washington	11.1	8.9	7.3	5.7
11	Hanover and Prince Streets	6.9	6.7	4.3	4.2
12	North Street and Surface Road	16.7	11.6	11.2	7.6
13	Congress and North Streets	17.1	9.6	11.5	6.2
14	Congress and State Streets	17.0	9.6	11.4	6.2
15	State Street and Surface Road	17.9	17.1	12.0	11.5
16	Summer and Purchase Streets	12.4	10.3	8.2	6.7
17	Congress and Purchase Streets	20.6	16.0	13.9	10.7
18	Northern and Atlantic Avenues	14.4	13.4	9.6	8.9
19	Kneeland and Hudson Streets	24.4	17.0	16.6	11.4
20	West Broadway/Herald and Albany	15.7	15.0	10.5	9.8
21	Massachusetts Avenue Connector/Southampton	20.3	16.3	13.7	10.9
22	Old Colony and D Street	13.0	7.7	8.6	4.9
23	Broadway and L Street	11.1	8.7	7.3	5.6
24	Northern Avenue and East Service Road	6.4	6.3	4.0	3.9
25	Central Square	7.3	7.1	4.6	4.5
26	East Boston Toll Plaza[1]	17.1	N/A	11.5	N/A
27	Neptune Road/Bennington and Route 1A	17.4	10.9	11.7	7.1
28	Day Square	8.0	6.1	5.1	3.8
29	Boardman and Route 1A	14.6	10.7	9.7	7.0
30	Bell Circle	16.7	11.1	11.2	7.3
31	East Boston Memorial Stadium Park	7.4	N/A	4.7	N/A
32	New East Boston Toll Plaza	8.1	N/A	5.2	N/A
33	Essex and Washington Streets	14.1	10.7	9.4	7.0
34	Cambridge and Staniford Streets	19.4	17.6	13.1	11.8

Table 4.8 (Cont.)

ESTIMATED 1-HOUR AND 8-HOUR WORST CASE CARBON MONOXIDE LEVELS IN 1987 BASED ON MICROSCALE MODELING (ppm)

Analysis Site		1-Hour Average		8-Hour Average	
No.	Location	Corner	Midblock	Corner	Midblock
35	Summer Street and Atlantic Avenue	11.0	11.6	7.2	7.6
36	Congress Street and Atlantic Avenue	18.9	14.0	13.3	9.3
37	Fargo and D Streets	6.7	6.0	4.12	3.7
38	A Street and Broadway	11.0	N/A	7.2	N/A
39	Third Street North of Railroad Tracks	5.3	N/A	3.2	N/A

1. Maximum concentration of estimates at six receptor locations (see Figure 4.2)
2. 1-hour AAQS = 35 ppm, 8-hour AAQS = 9 ppm
3. All values include 1-hour CO background level of 5.0 ppm, or 8-hour CO background level of 3.0 ppm
4. N/A: Not applicable
5. See Figure 4.1 for locations of analysis sites

Source: Bechtel/Parsons Brinckerhoff

changes in "pollutant burdens" (i.e., the tons of pollutants emitted each day or year) provide an indication of the general change in air quality in the region, and are useful in assessing relative changes in the concentrations of CO, HC, NO_x, and ozone. CO, HC, and NO_x pollutant burdens were computed based on the estimated vehicle miles traveled (VMT), vehicle hours travelled (VHT), average travel speed, and vehicle mix for all major roadways in the study area.

4.4.3(a) Study Areas

All major highways, roadways and local streets affected by the project were included in this assessment. In order to evaluate project impacts in the primary neighborhoods in Boston, six major geographic zones within the overall network were considered individually: Area North of Causeway, Central Area, I-93/I-90 Interchange, South Boston, East Boston, and East Cambridge. (Figure 4.3 shows the boundaries of each of these zones.)

4.4.3(b) Traffic Data

VMT and VHT were estimated for each of the six major geographic zones as part of the overall project traffic analysis (see Table 4.9). Average vehicular speeds were obtained by dividing VMT by VHT.

4.4.3(c) Meteorological Conditions And Analysis Periods

The mesoscale analysis was conducted as follows:

- o Daily pollutant emissions were estimated assuming an average summertime temperature of 70°F to determine the maximum potential effects on peak ozone levels, since ozone is of primary concern during the summer season.

- o Annual pollutant emissions were estimated by multiplying estimated daily levels by 331 days per year (to account for traffic levels on both weekdays and weekends). Annual emissions estimates were used to evaluate the consistency of the project with the State Implementation Plan (SIP), which is based on estimated annual areawide pollutant levels.

4.4.3(d) Emission Rates

Air pollutant emission rates were estimated using the most recent version of the EPA mobile source emission factor model, MOBILE 4.

4.4.3(e) Estimated Existing (1987) Areawide Emissions

Estimated peak daily and annual areawide emissions of CO, HC, and NO_x are provided in Tables 4.10 and 4.11. The results indicate that a total of 37,774 tons per year of CO, 5,173 tons per year of HC, and 3,172 tons per year of NO_x were emitted from motor vehicles using the roadway network in the study area in 1987.

In addition, the results of the analysis also indicated that a peak total of approximately 114 tons per day of CO, 16 tons per day of HC, and 10 tons per day of NO_x were emitted daily in the study area in 1987. Of these totals, approximately 71 percent of the CO, 62 percent of the HC, and 53 percent of the NO_x were emitted from motor vehicles using local streets.

Table 4.9

TRAFFIC PARAMETERS USED TO ESTIMATE AREAWIDE EMISSION BURDENS FOR THE YEAR 1987

Affected Area	Vehicle Miles Travelled Per Day	Vehicle Hours Travelled Per Day	Average Network Speed Per Day (mph)
Area North of Causeway			
Highways and Ramps	504,005	21,235	23.7
Local Streets	218,650	18,231	12.0
Central Area			
Highways and Ramps	745,168	34,985	21.3
Local Streets	507,104	58,267	8.7
I-93/I-90 Interchange			
Highways and Ramps	436,821	13,756	31.8
Local Streets	251,308	19,931	12.6
South Boston			
Highways and Ramps	0	0	0
Local Streets	319,591	33,177	9.6
East Boston			
Highways and Ramps	325,030	11,376	28.6
Local Streets	178,205	12,474	14.3
East Cambridge			
Highways and Ramps	0	0	0
Local Streets	394,706	43,030	9.2
Totals	3,880,588	266,463	14.6

Source: Bechtel/Parsons Brinckerhoff

FIGURE 4.3

Affected Zones For Meso Scale Air Quality Analysis

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

0 1600 3200 4800 6400 Feet

Table 4.10

PEAK DAILY EMISSION BURDENS IN THE STUDY AREA
(tons per day)
1987

Affected Zone	CO	HC	NO_x
Area North of Causeway			
Highways and Ramps	8.49	1.52	1.13
Local Streets	8.03	1.01	0.58
Central Area			
Highways and Ramps	13.92	2.35	1.70
Local Streets	25.47	2.89	1.34
I-93/I-90 Interchange			
Highways and Ramps	5.42	1.15	0.96
Local Streets	9.04	1.16	0.71
South Boston			
Highways and Ramps	0.00	0.00	0.00
Local Streets	14.98	1.75	0.95
East Boston			
Highways and Ramps	4.51	0.90	0.72
Local Streets	5.43	0.73	0.38
East Cambridge			
Highways and Ramps	0.00	0.00	0.00
Local Streets	18.82	2.17	1.11
Totals	114.12	15.63	9.58

Source: Bechtel/Parsons Brinckerhoff

Table 4.11

ANNUAL EMISSION BURDENS IN THE STUDY AREA
(tons per year)
1987

Affected Zone	CO	HC	NO_x
Area North of Causeway			
Highways and Ramps	2,809	502	375
Local Streets	2,658	335	192
Central Area			
Highways and Ramps	4,607	779	562
Local Streets	8,431	995	445
I-93/I-90 Interchange			
Highways and Ramps	1,794	382	318
Local Streets	2,994	383	235
South Boston			
Highways and Ramps	0	0	0
Local Streets	4,957	579	315
East Boston			
Highways and Ramps	1,494	299	237
Local Streets	1,798	241	127
East Cambridge			
Highways and Ramps	0	0	0
Local Streets	6,231	719	366
Totals	37,774	5,173	3,172

Source: Bechtel/Parsons Brinckerhoff

4.5 ENVIRONMENTAL CONSEQUENCES: CARBON MONOXIDE LEVELS IN 1998 WITH AND WITHOUT THE PROPOSED ACTION

An analysis was completed of the impact of the project on pollutants levels in the year 1998, the estimated year of completion of the entire Artery/Tunnel Project. The analysis included a microscale analysis to estimate future (1998) CO levels in the vicinity of the project alignment, and a mesoscale analysis to estimate future (1998) quantities of CO, HC and NO_x emitted in the Boston region.

4.5.1 Estimated CO Levels In 1998 Based On Microscale Modeling

4.5.1(a) Methodology

A microscale analysis was used to estimate future (1998) CO levels in the vicinity of the project alignment at the same 39 receptor locations and using the same modeling techniques that were used to estimate existing (1987) CO levels in the project area, including use of the EPA MOBILE 4 mobile source emission factor program to estimate vehicular emissions, and the use of the CAL3QHC air quality dispersion program to predict pollutant concentrations.

Traffic data for this analysis were derived from the traffic counts, speed data and other information developed as part of the traffic analysis for the SEIS/R. The analysis was based on estimated traffic levels during the peak 8-hour traffic period (10 AM to 6 PM). Consistent with the procedures used to estimate existing (1987) CO levels, peak 1-hour concentrations of CO were obtained by dividing peak 8-hour CO levels by 0.7 to account for the observed fact that vehicle volumes, vehicle speeds and meteorological conditions during the 8-hour period will vary from those that will persist for only 1 hour.

CO background levels used in this analysis are presented in Table 4.7. These values were developed in consultation with EPA and DEP, on the basis of 1987 background CO levels for the 8-hour and 1-hour averaging periods, and adjusted to reflect projected changes in future required CO emissions from current levels. These adjustments were completed on the basis of the following assumptions:

- o Ten percent of the CO emissions in the region are currently from sources other than vehicular emissions, and that this level will remain constant for the years 1998 and 2010.

- o Ten percent of the CO emissions in the region are generated by motor vehicles travelling in the Artery/Tunnel Project study area.

- o Eighty percent of the CO emissions in the region are generated by motor vehicles travelling outside of the Artery/Tunnel Project study area. This traffic will increase 17 percent between 1987 and 1998, and a 27 percent between 1987 and 2010.

4.5.1(b) Results

The results of the CO microscale analysis are summarized in Tables 4.12 and 4.13. Provided are estimates of 1-hour and 8-hour concentrations of CO for midblock and intersection locations in the vicinity of each nominal analysis site, with and without the proposed action. The results of the analysis indicate that:

Table 4.12

ESTIMATED 1-HOUR WORST CASE CARBON MONOXIDE LEVELS IN 1998 WITH AND WITHOUT THE PROPOSED ACTION (ppm)

Analysis Site		Without the Artery/ Tunnel Project		With the Artery/ Tunnel Project	
No.	Location	Corner	Midblock	Corner	Midblock
1	Charlestown Avenue and O'Brien Highway	8.6	7.3	9.3	9.0
2	City Square	7.6	8.3	6.0	6.2
3	Leverett Circle	8.6	8.1	8.5	5.5
4	Causeway/Merrimac/Lomasney	9.3	9.6	8.6	6.3
5	Causeway and Haverhill Streets	7.3	6.1	5.0	4.9
6	Causeway and Beverly Streets	6.9	5.9	6.0	4.6
7	North Washington and Commercial Streets	15.7	10.1	8.5	5.0
8	New Sudbury and Congress Streets	8.9	6.9	8.9	6.2
9	New Chardon/Haverhill/North Washington	5.4	5.3	6.0	4.5
10	New Chardon/Stillman/North Washington	5.6	4.7	6.3	4.8
11	Hanover and Prince Streets	3.6	3.7	3.2	3.2
12	North Street and Surface Road	7.9	6.1	4.3	3.6
13	Congress and North Streets	6.7	4.9	6.2	4.5
14	Congress and State Streets	7.4	5.0	6.8	4.6
15	State Street and Surface Road	9.9	8.7	7.0	4.8
16	Summer and Purchase Streets	7.6	6.6	9.0	5.3
17	Congress and Purchase Streets	9.6	8.1	11.8	11.8
18	Northern and Atlantic Avenues	13.3	7.7	9.9	5.9
19	Kneeland and Hudson Streets	10.3	9.0	10.3	9.3
20	West Broadway/Herald and Albany	9.1	8.1	6.2	6.3
21	Massachusetts Avenue Connector/Southampton	10.3	10.9	10.0	7.8
22	Old Colony and D Street	6.3	4.3	5.9	4.5
23	Broadway and L Street	6.7	4.6	5.2	4.6
24	Northern Avenue and East Service Road	4.6	4.6	5.8	3.9
25	Central Square	4.1	3.4	3.9	3.2
26	East Boston Toll Plaza	6.9	N/A	5.6	N/A
27	Neptune Road/Bennington and Route 1A	7.9	6.1	7.5	5.3
28	Day Square	4.3	3.6	4.2	3.3
29	Boardman and Route 1A	6.7	4.7	6.2	4.9
30	Bell Circle	9.0	5.9	7.6	5.3
31	East Boston Memorial Stadium Park	4.7	N/A	4.6	N/A
32	New East Boston Toll Plaza	5.3	N/A	4.9	N/A
33	Essex and Washington Streets	6.7	5.7	6.3	5.9

Table 4.12 (Cont.)

ESTIMATED 1-HOUR WORST CASE CARBON MONOXIDE LEVELS IN 1998 WITH AND WITHOUT THE PROPOSED ACTION (ppm)

Analysis Site		Without the Artery/ Tunnel Project		With the Artery/ Tunnel Project	
No.	Location	Corner	Midblock	Corner	Midblock
34	Cambridge and Staniford Streets	7.7	7.6	7.3	6.5
35	Summer Street and Atlantic Avenue	7.1	6.7	6.0	6.0
36	Congress Street and Atlantic Avenue	8.6	7.1	8.6	5.0
37	Fargo Street and D Street	3.9	3.4	3.8	3.6
38	A Street and Broadway (High School)	5.0	N/A	5.2	N/A
39	Third Street North of Railroad Tracks	3.1	N/A	3.2	N/A

1. One-hour AAQS for carbon monoxide = 35 ppm
2. All values include 1-hour CO background level of 3.0 ppm for conditions without the Artery/Tunnel Project, and 2.9 ppm for conditions with the Artery/Tunnel Project
3. N/A: Not applicable

Source: Bechtel/Parsons Brinckerhoff

Table 4.13

ESTIMATED 8-HOUR WORST CASE CARBON MONOXIDE LEVELS IN 1998 WITH AND WITHOUT THE PROPOSED ACTION (ppm)

Analysis Site		Without the Artery/ Tunnel Project		With the Artery/ Tunnel Project	
No.	Location	Corner	Midblock	Corner	Midblock
1	Charlestown Avenue and O'Brien Highway	5.7	4.8	6.3	6.1
2	City Square	5.0	5.5	4.0	4.1
3	Leverett Circle	5.7	5.4	5.7	3.6
4	Causeway/Merrimac/Lomasney	6.2	6.4	5.8	4.2
5	Causeway and Haverhill Streets	4.8	4.0	3.3	2.9
6	Causeway and Beverly Streets	4.5	3.8	4.0	3.0
7	North Washington and Commercial Streets	10.7	6.8	5.7	3.3
8	New Sudbury and Congress Streets	5.9	4.5	6.0	4.1
9	New Chardon/Haverhill/North Washington	3.5	3.4	4.0	2.9
10	New Chardon/Stillman/North Washington	3.6	3.0	4.2	3.1
11	Hanover and Prince Streets	2.2	2.3	2.0	2.0
12	North Street and Surface Road	5.2	4.0	2.8	2.3
13	Congress and North Streets	4.4	3.1	4.1	2.9
14	Congress and State Streets	4.9	3.2	4.5	3.0
15	State Street and Surface Road	6.6	5.8	4.7	3.1
16	Summer and Purchase Streets	5.0	4.3	6.1	3.5
17	Congress and Purchase Streets	6.4	5.4	8.0	8.0
18	Northern and Atlantic Avenues	9.0	5.1	6.7	3.9
19	Kneeland and Hudson Streets	6.9	6.0	7.0	6.3
20	West Broadway/Herald and Albany	6.1	5.4	4.1	4.2
21	Massachusetts Avenue Connector/Southampton	6.9	7.3	6.8	5.2
22	Old Colony and D Street	4.1	2.7	3.9	2.9
23	Broadway and L Street	4.4	2.9	3.4	3.0
24	Northern Avenue and East Service Road	2.9	2.9	3.8	2.5
25	Central Square	2.6	2.1	2.5	2.0
26	East Boston Toll Plaza	4.5	N/A	3.7	N/A
27	Neptune Road/Bennington and Route 1A	5.2	4.0	5.0	3.5
28	Day Square	2.7	2.2	2.7	2.1
29	Boardman and Route 1A	4.4	3.0	4.1	3.2
30	Bell Circle	6.0	3.8	5.1	3.5
31	East Boston Memorial Stadium Park	3.0	N/A	3.0	N/A
32	New East Boston Toll Plaza	3.4	N/A	3.2	N/A
33	Essex and Washington Streets	4.4	3.7	4.2	3.9

Table 4.13 (Cont.)

ESTIMATED 8-HOUR WORST CASE CARBON MONOXIDE LEVELS IN 1998 WITH AND WITHOUT THE PROPOSED ACTION (ppm)

Analysis Site		Without the Artery/ Tunnel Project		With the Artery/ Tunnel Project	
No.	**Location**	**Corner**	**Midblock**	**Corner**	**Midblock**
34	Cambridge and Staniford Streets	5.1	5.0	4.9	4.3
35	Summer Street and Atlantic Avenue	4.7	4.4	4.0	4.0
36	Congress Street and Atlantic Avenue	5.7	4.7	5.8	3.3
37	Fargo Street and D Street	2.4	2.1	2.4	2.3
38	A Street and Broadway (High School)	3.2	N/A	3.4	N/A
39	Third Street North of Railroad Tracks	1.9	N/A	2.0	N/A

1. Eight-hour AAQS for carbon monoxide = 9 ppm
2. All values include 8-hour CO background level of 1.8 ppm
3. N/A: Not applicable

Source: Bechtel/Parsons Brinckerhoff

- o One-hour CO concentrations in 1998 with or without the Artery/Tunnel Project will be less than (in compliance with) the National and Massachusetts AAQS of 35 ppm at all locations analyzed. The maximum 1-hour CO concentrations in 1998 with the Artery/Tunnel Project in place (11.8 ppm) was estimated near the intersection of Congress and Purchase Streets.

- o Eight-hour CO concentrations in 1998 with or without the Artery/Tunnel Project will be less than (in compliance with) the AAQS of 9 ppm at all locations analyzed. The maximum 8-hour CO concentrations in 1998 with the Artery/Tunnel Project (8.0 ppm) was estimated near the intersection of Congress and Purchase Streets.

- o CO concentrations with the Proposed Action were equal to or less than those without the Proposed Action at 28 of the 39 locations analyzed.

- o CO concentrations in 1998 will be less than CO concentrations in 1987 at all locations with or without the Proposed Action. This is to a great extent a result of the lower emission rates predicted in the MOBILE 4 emission factor model for future years. These lower emission rates are attributed to the wider use of cleaner vehicles, including an increase in the number of vehicles using multiport fuel injection systems, in future years.

4.5.2 Estimated Areawide Pollutant Emissions In 1998 With And Without The Proposed Action

4.5.2(a) Methodology

CO, HC, and NO_x pollutant burdens were computed for the same overall study area, and six primary neighborhoods and using the same methodology and assumed meteorological conditions for which pollutants burdens were estimated for 1987.

4.5.2(b) Traffic Data

Traffic data used in the analysis are summarized in Table 4.14. Without the Artery/Tunnel Project, estimated vehicle miles of travel increased 22 percent, vehicles hours of travel increased 26 percent, vehicle hours of travel increased 10 percent, and average network speed increased 14 percent compared to existing (1987) conditions, and estimated vehicle miles of travel increased 3 percent, vehicle hours of travel decreased 25 percent, and average network speed increased 39 percent compared to conditions in 1998 without the Artery/Tunnel Project.

4.5.2(c) Estimated Future Build Year (1998) Areawide Emissions

Estimated peak daily and annual areawide emissions of CO, HC, and NO_x in the year 1998 are shown in Tables 4.15 and 4.16. The results indicate that a total of 15,638 tons per year of CO, 2,376 tons per year of HC, and 1,883 tons per year of NO_x will be emitted from motor vehicles using the roadway network in the study area in 1998 if the Artery/Tunnel Project is not constructed, and a total of 12,187 tons per year of CO, 1,981 tons per year of HC, and 1,754 tons per year of NO_x will be emitted from motor vehicles using the roadway network in the study area in 1998 if the Artery/Tunnel Project is constructed. The results of the analysis also indicate that a total of approximately 37 tons per day of CO, 6 tons per day of HC, and 5 tons per day of NO_x will be emitted with the Artery/Tunnel Project.

Table 4.14

TRAFFIC PARAMETERS USED TO ESTIMATE AREAWIDE EMISSION BURDENS FOR THE YEAR 1998

Affected Area	Vehicle Miles Travelled Per Day: Without Project	Vehicle Miles Travelled Per Day: With Project	Vehicle Hours Travelled Per Day: Without Project	Vehicle Hours Travelled Per Day: With Project	Average Network Speed (MPH) Per Day: Without Project	Average Network Speed (MPH) Per Day: With Project
Area North of Causeway						
Highways and Ramps	626,630	759,076	26,589	24,168	23.6	31.4
Local Streets	280,540	280,540	235,069	17,759	9.6	13.2
Central Area						
Highways and Ramps	854,823	897,497	46,556	32,501	18.4	27.6
Local Streets	585,670	498,245	84,540	52,053	6.9	9.6
I-93/I-90 Interchange						
Highways and Ramps	495,285	542,978	18,062	18,505	27.4	29.3
Local Streets	315,814	315,207	30,064	31,362	10.5	10.1
South Boston						
Highways and Ramps	0	276,815	0	6,475	N/A	42.7
Local Streets	416,378	336,377	42,454	35,566	9.8	9.5
East Boston						
Highways and Ramps	292,808	377,189	12,703	11,400	23.0	33.1
Local Streets	349,095	201,611	27,602	14,622	12.6	13.8
East Cambridge						
Highways and Ramps	0	0	0	0	N/A	N/A
Local Streets	503,811	436,327	75,060	47,824	6.7	9.1
Totals	4,720,852	4,876,390	392,855	292,235	12.0	16.7

Source: Bechtel/Parsons Brinckerhoff

Table 4.15

PEAK DAILY EMISSION BURDENS IN THE STUDY AREA
(tons per day)
1998

Affected Zone	CO Without The Project	CO Proposed Action	CO Change[1]	HC Without The Project	HC Proposed Action	HC Change[1]	NO_x Without The Project	NO_x Proposed Action	NO_x Change[1]
Area North of Causeway									
Highways and Ramps	3.47	3.15	(0.32)	0.59	0.63	0.04	0.61	0.68	0.07
Local Streets	3.54	2.47	(1.07)	0.52	0.35	(0.17)	0.40	0.31	(0.09)
Central Area									
Highways and Ramps	6.39	4.24	(2.15)	0.91	0.78	(0.13)	0.91	0.83	(0.08)
Local Streets	9.00	6.22	(2.78)	1.38	0.92	(0.47)	0.83	0.66	(0.17)
I-93/I-90 Interchange									
Highways and Ramps	2.35	2.42	0.06	0.44	0.46	0.03	0.46	0.49	0.03
Local Streets	3.88	3.95	0.08	0.56	0.58	0.01	0.44	0.44	0.00
South Boston									
Highways and Ramps	0.00	0.82	0.82	0.00	0.20	0.20	0.00	0.23	0.23
Local Streets	5.32	4.38	(0.94)	0.78	0.64	(0.14)	0.59	0.48	(0.11)
East Boston									
Highways and Ramps	1.66	1.48	(0.18)	0.28	0.31	0.03	0.29	0.33	0.04
Local Streets	3.66	2.01	(1.64)	0.52	0.28	(0.24)	0.40	0.23	(0.18)
East Cambridge									
Highways and Ramps	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Local Streets	7.99	5.68	(2.31)	1.23	0.84	(0.39)	0.77	0.62	(0.14)
Totals	47.24	36.82	(10.43)	7.18	5.98	(1.20)	5.70	5.30	(0.40)

1. Change = the difference in emissions with/without the project

Source: Bechtel/Parsons Brinckerhoff

Table 4.16

ANNUAL EMISSION BURDENS IN THE STUDY AREA
(tons per year)
1998

Affected Zone	CO Without The Project	CO Proposed Action	CO Change[1]	HC Without The Project	HC Proposed Action	HC Change[1]	NO_x Without The Project	NO_x Proposed Action	NO_x Change[1]
Area North of Causeway									
Highways and Ramps	1,147	1,043	(104)	195	209	14	201	224	22
Local Streets	1,171	818	(353)	173	116	(57)	131	101	(30)
Central Area									
Highways and Ramps	2,114	1,402	(711)	300	258	(41)	300	273	(27)
Local Streets	2,980	2,058	(921)	461	303	(158)	275	219	(56)
I-93/I-90 Interchange									
Highways and Ramps	779	800	21	144	153	9	152	164	11
Local Streets	1,283	1,308	26	174	191	17	146	147	1
South Boston									
Highways and Ramps	0	270	270	0	65	65	0	76	76
Local Streets	1,761	1,451	(311)	258	213	(45)	196	159	(36)
East Boston									
Highways and Ramps	550	491	(59)	92	101	9	95	110	15
Local Streets	1,210	666	(544)	172	93	(79)	133	75	(58)
East Cambridge									
Highways and Ramps	0	0	0	0	0	0	0	0	0
Local Streets	2,645	1,880	(764)	407	279	(128)	253	207	(47)
Totals	15,637	12,187	(3,450)	2,376	1,981	(396)	1,882	1,755	(129)

1. Change = the difference in emissions with/without the project

Source: Bechtel/Parsons Brinckerhoff

Of these totals, approximately 71 percent of the CO, 69 percent of the HC, and 60 percent of the NO_x were emitted from motor vehicles using local streets without the Artery/Tunnel Project, and approximately 67 percent of the CO, 60 percent of the HC, and 52 percent of the NO_x were emitted from motor vehicles using local streets with the Artery/Tunnel Project. These results indicate that there will be both a net decrease (improvement) in the amount of CO, HC and NO_x emissions in 1998 with the Artery/Tunnel Project, and a net decrease (improvement) in the percentage of emissions from motor vehicles using local streets in the study area roadway network with the Artery/Tunnel Project, both compared against existing (1987) conditions, and compared against conditions in the year 1998 without the project.

Overall, compared with the 1998 future no-action condition, the project will result in a 22 percent reduction in CO, a 17 percent reduction in HC, and a 7 percent reduction in NO_x.

4.6 ENVIRONMENTAL CONSEQUENCES: CARBON MONOXIDE LEVELS IN 2010 WITH AND WITHOUT THE PROPOSED ACTION

An analysis was completed of the impact of the project on pollutant levels in the year 2010, the project design year. The analysis included a microscale analysis to estimate future (2010) CO levels in the vicinity of the project alignment, and a mesoscale analysis to estimate future (2010) quantities of CO, HC, and NO_x with and without the Proposed Action.

4.6.1 Estimated CO Levels In 2010 Based On Microscale Modeling

4.6.1(a) Methodology

A microscale analysis was prepared to estimate future (2010) CO levels in the vicinity of the project alignment at the same 39 receptor locations, employing the same modeling techniques that were used to estimate existing (1987) and 1998 CO levels in the project area. CO background levels used in this analysis are presented in Table 4.7, and were developed using the same methodology and assumptions as those applied to estimate year 1998 CO background levels.

4.6.1(b) Results

The results of the CO microscale analysis are summarized in Tables 4.17 and 4.18. Provided are estimates of 1-hour and 8-hour concentrations of CO for midblock and intersection locations in the vicinity of each nominal analysis site, with and without the Proposed Action. The results of this analysis indicate that:

- o One-hour CO concentrations in 2010 with or without the Artery/Tunnel Project would be less than (in compliance with) the National and Massachusetts AAQS of 35 ppm at all locations analyzed. The maximum 1-hour CO concentration in 2010 with the Artery/Tunnel Project (11.7 ppm) was estimated near the intersection of Northern and Atlantic Avenues.

- o CO concentrations with the Proposed Action will be less than those without the Proposed Action at 27 of the 39 locations analyzed.

Table 4.17

ESTIMATED 1-HOUR WORST CASE CARBON MONOXIDE LEVELS IN 2010 WITH AND WITHOUT THE PROPOSED ACTION (ppm)

Analysis Site		Without the Artery/ Tunnel Project		With the Artery/ Tunnel Project	
No.	Location	Corner	Midblock	Corner	Midblock
1	Charlestown Avenue and O'Brien Highway	8.2	7.5	10.1	9.0
2	City Square	7.7	8.5	6.0	6.3
3	Leverett Circle	8.5	7.8	7.9	5.0
4	Causeway/Merrimac/Lomasney	7.1	6.4	8.4	6.3
5	Causeway and Haverhill Streets	7.8	6.8	5.3	4.6
6	Causeway and Beverly Streets	7.2	6.1	6.4	4.7
7	North Washington and Commercial Streets	11.2	10.1	8.6	5.3
8	New Sudbury and Congress Streets	8.4	7.2	8.4	6.3
9	New Chardon/Haverhill/North Washington	5.7	5.5	6.3	4.6
10	New Chardon/Stillman/North Washington	5.8	4.8	6.4	4.9
11	Hanover and Prince Streets	3.8	3.8	3.3	3.4
12	North Street and Surface Road	8.0	6.1	4.6	3.9
13	Congress and North Streets	6.2	5.0	6.0	4.4
14	Congress and State Streets	7.4	5.1	6.7	4.7
15	State Street and Surface Road	11.1	11.5	6.7	4.6
16	Summer and Purchase Streets	7.7	6.4	8.9	5.6
17	Congress and Purchase Streets	10.1	8.2	10.1	9.6
18	Northern and Atlantic Avenues	11.7	7.5	9.7	5.9
19	Kneeland and Hudson Streets	9.8	9.1	9.9	8.9
20	West Broadway/Herald and Albany	9.0	8.2	6.4	5.9
21	Massachusetts Avenue Connector/Southampton	9.8	8.2	9.4	7.4
22	Old Colony and D Street	6.4	5.7	5.9	4.9
23	Broadway and L Street	6.7	4.8	5.1	4.0
24	Northern Avenue and East Service Road	4.5	4.5	5.9	4.1
25	Central Square	4.2	3.7	4.0	3.3
26	East Boston Toll Plaza	7.0	N/A	5.9	N/A
27	Neptune Road/Bennington and Route 1A	8.0	6.2	7.1	5.3
28	Day Square	4.5	4.0	4.0	3.4
29	Boardman and Route 1A	7.0	5.1	6.7	5.7
30	Bell Circle	7.4	5.9	7.1	5.4
31	East Boston Memorial Stadium Park	5.0	N/A	4.7	N/A
32	New East Boston Toll Plaza	5.5	N/A	5.0	N/A
33	Essex and Washington Streets	6.5	5.8	6.1	6.0

Table 4.17 (Cont.)

ESTIMATED 1-HOUR WORST CASE CARBON MONOXIDE LEVELS IN 2010 WITH AND WITHOUT THE PROPOSED ACTION (ppm)

Analysis Site		Without the Artery/ Tunnel Project		With the Artery/ Tunnel Project	
No.	Location	Corner	Midblock	Corner	Midblock
34	Cambridge and Staniford Streets	7.7	8.0	6.7	6.0
35	Summer Street and Atlantic Avenue	6.8	6.5	6.0	6.1
36	Congress Street and Atlantic Avenue	9.1	10.8	8.3	5.0
37	Fargo Street and D Street	4.1	3.7	3.7	3.9
38	A Street and Broadway (High School)	4.8	N/A	5.0	N/A
39	Third Street North of Railroad Tracks	3.2	N/A	3.4	N/A

1. One hour AAQS for carbon monoxide = 35 ppm
2. Values include 1-hour CO background level of 3.1 ppm for conditions without the Artery/Tunnel Project, and 3.0 ppm for conditions with the Artery/Tunnel Project
3. N/A: Not applicable

Source: Bechtel/Parsons Brinckerhoff

Table 4.18

ESTIMATED 8-HOUR WORST CASE CARBON MONOXIDE LEVELS IN 2010 WITH AND WITHOUT THE PROPOSED ACTION (ppm)

Analysis Site		Without the Artery/ Tunnel Project		With the Artery/ Tunnel Project	
No.	Location	Corner	Midblock	Corner	Midblock
1	Charlestown Avenue and O'Brien Highway	5.4	4.9	6.8	6.0
2	City Square	5.0	5.6	3.9	4.1
3	Leverett Circle	5.6	5.1	5.2	3.2
4	Causeway/Merrimac/Lomasney	4.6	4.1	5.6	4.1
5	Causeway and Haverhill Streets	5.1	4.4	3.4	2.9
6	Causeway and Beverly Streets	4.7	3.9	4.2	3.0
7	North Washington and Commercial Streets	7.5	6.7	5.7	3.4
8	New Sudbury and Congress Streets	5.5	4.7	5.6	4.1
9	New Chardon/Haverhill/North Washington	3.6	3.5	4.1	2.9
10	New Chardon/Stillman/North Washington	3.7	3.0	4.2	3.1
11	Hanover and Prince Streets	2.3	2.3	2.0	2.1
12	North Street and Surface Road	5.2	3.9	2.9	2.4
13	Congress and North Streets	4.0	3.1	3.9	2.8
14	Congress and State Streets	4.8	3.2	4.4	3.0
15	State Street and Surface Road	7.4	7.7	4.4	2.9
16	Summer and Purchase Streets	5.0	4.1	5.9	3.6
17	Congress and Purchase Streets	6.7	5.4	6.8	6.4
18	Northern and Atlantic Avenues	7.8	4.9	6.5	3.8
19	Kneeland and Hudson Streets	6.5	6.0	6.6	5.9
20	West Broadway/Herald and Albany	5.9	5.4	4.2	3.8
21	Massachusetts Avenue Connector/Southampton	6.5	5.4	6.3	4.8
22	Old Colony and D Street	4.1	3.6	3.8	3.1
23	Broadway and L Street	4.3	3.0	3.3	2.5
24	Northern Avenue and East Service Road	2.8	2.8	3.8	2.6
25	Central Square	2.6	2.2	2.5	2.0
26	East Boston Toll Plaza	4.5	N/A	3.8	N/A
27	Neptune Road/Bennington and Route 1A	5.2	4.0	4.7	3.4
28	Day Square	2.8	2.4	2.5	2.1
29	Boardman and Route 1A	4.5	3.2	4.4	3.7
30	Bell Circle	4.8	3.5	4.7	3.5
31	East Boston Memorial Stadium Park	3.1	N/A	3.0	N/A
32	New East Boston Toll Plaza	3.5	N/A	3.2	N/A
33	Essex and Washington Streets	4.2	3.7	4.0	3.9

Table 4.18 (Cont.)

ESTIMATED 8-HOUR WORST CASE CARBON MONOXIDE LEVELS IN 2010 WITH AND WITHOUT THE PROPOSED ACTION (ppm)

Analysis Site		Without the Artery/ Tunnel Project		With the Artery/ Tunnel Project	
No.	Location	Corner	Midblock	Corner	Midblock
34	Cambridge and Staniford Streets	5.0	5.2	4.4	3.9
35	Summer Street and Atlantic Avenue	4.4	4.2	3.9	4.0
36	Congress Street and Atlantic Avenue	6.0	7.2	5.5	3.2
37	Fargo Street and D Street	2.5	2.2	2.3	2.4
38	A Street and Broadway (High School)	3.0	N/A	3.2	N/A
39	Third Street North of Railroad Tracks	1.9	N/A	2.1	N/A

1. Eight-hour AAQS for carbon monoxide = 9 ppm
2. All values include 8-hour CO background level of 1.8 ppm
3. N/A: Not applicable

Source: Bechtel/Parsons Brinckerhoff

- o Eight-hour CO concentrations in 2010 with or without the Artery/Tunnel Project would be less than (in compliance with) the AAQS of 9 ppm at all locations.

- o CO concentrations in 2010 would be less than CO concentrations in 1987 with or without the Artery/Tunnel Project at all locations.

The few locations where higher CO levels with the project will occur will be generally caused by:

- o Increased traffic volumes at a particular location due to motor vehicles approaching or leaving access points to the Artery/Tunnel Project.

- o Localized reductions in roadway capacity related to the required construction or operation of the Proposed Action.

- o Changes in movement direction of particular roadway links related to the Proposed Action.

4.6.2 Estimated Areawide Pollutant Emissions In 2010 With And Without The Proposed Action

4.6.2(a) Methodology

CO, HC, and NO_x pollutant burdens were computed for the same overall study area, and six primary neighborhoods, using the same methodology and assumed meteorological conditions for which pollutant burdens were estimated for 1987 and 1998.

4.6.2(b) Traffic Data

Traffic data used in the analysis are summarized in Table 4.19. Without the Artery/Tunnel Project, estimated vehicle miles of travel increased 38 percent, vehicle hours of travel increased 85 percent, and average network speed decreased 29 percent compared to existing (1987) conditions. With the Artery/Tunnel Project, estimated vehicle miles of travel increased 36 percent, vehicle hours of travel increased 32 percent, and average network speed increased 3 percent compared to existing (1987) conditions, and estimated vehicle miles of travel increased 3 percent, vehicle hours of travel decreased 29 percent, and average network speed increased 44 percent compared to conditions in 2010 without the Artery/Tunnel Project.

4.6.2(c) Estimated Future Design Year (2010) Areawide Emissions

Estimated peak daily and annual areawide emissions of CO, HC and NO_x in the design year (2010) are provided in Tables 4.20 and 4.21. The results indicate that a total of 16,170 tons per year of CO, 2,740 tons per year of HC, and 1,927 tons per year of NO_x will be emitted from motor vehicles using the roadway network in the study area in 2010 if the Artery/Tunnel Project is not constructed, and a total of 12,576 tons per year of CO, 2,211 tons per year of HC, and 1,773 tons per year of NO_x will be emitted from motor vehicles using the study area roadway network in 2010 if the Artery/Tunnel Project is constructed. The results of the analysis also indicate that a peak total of approximately 49 tons per day of CO, 8 tons per day of HC, and 6 tons per day of NO_x will be emitted from motor vehicles in 2010 without the Artery/Tunnel Project, and approximately 38 tons per day of CO, 7 tons per day of HC, and 5 tons per day of NO_x will be emitted with the Artery/Tunnel Project.

Table 4.19

TRAFFIC PARAMETERS USED TO ESTIMATE AREAWIDE EMISSION BURDENS FOR THE YEAR 2010

	Vehicle Miles Travelled Per Day		Vehicle Hours Travelled Per Day		Average Network Speed (MPH) Per Day	
Affected Area	**Without Project**	**With Project**	**Without Project**	**With Project**	**Without Project**	**With Project**
Area North of Causeway						
Highways and Ramps	667,637	823,163	30,977	28,757	21.6	28.6
Local Streets	301,626	253,727	35,761	20,220	8.4	12.5
Central Area						
Highways and Ramps	910,961	967,330	57,151	36,636	15.9	26.4
Local Streets	647,221	539,221	106,359	61,110	6.1	8.8
I-93/I-90 Interchange						
Highways and Ramps	525,721	577,074	20,589	21,382	25.5	27.0
Local Streets	352,598	342,550	38,211	40,224	9.2	8.5
South Boston						
Highways and Ramps	0	300,979	0	8,502	N/A	35.4
Local Streets	469,324	377,408	57,187	44,919	8.2	8.4
East Boston						
Highways and Ramps	316,989	406,607	14,546	13,212	21.8	30.8
Local Streets	380,552	218,030	34,075	15,950	11.2	13.7
East Cambridge						
Highways and Ramps	0	0	0	0	N/A	N/A
Local Streets	547,414	472,724	97,761	60,372	5.6	7.8
Totals	5,120,043	5,278,814	492,617	351,284	10.4	15.0

Source: Bechtel/Parsons Brinckerhoff

Table 4.20

PEAK DAILY EMISSION BURDENS IN THE STUDY AREA
(tons per day)
2010

Affected Zone	CO Without The Project	CO Proposed Action	CO Change[1]	HC Without The Project	HC Proposed Action	HC Change[1]	NO_x Without The Project	NO_x Proposed Action	NO_x Change[1]
Area North of Causeway									
Highways and Ramps	3.83	3.56	(0.27)	0.64	0.69	0.05	0.59	0.67	0.07
Local Streets	3.51	2.46	(1.04)	0.59	0.38	(0.21)	0.40	0.31	(0.09)
Central Area									
Highways and Ramps	6.91	4.53	(2.38)	1.03	0.85	(0.18)	0.90	0.81	(0.09)
Local Streets	8.80	6.07	(2.74)	1.60	1.01	(0.59)	0.87	0.68	(0.19)
I-93/I-90 Interchange									
Highways and Ramps	2.55	2.64	0.09	0.47	0.50	0.03	0.45	0.48	0.03
Local Streets	4.01	4.05	0.04	0.66	0.68	0.02	0.47	0.46	0.00
South Boston									
Highways and Ramps	0.00	1.05	1.05	0.00	0.23	0.23	0.00	0.23	0.23
Local Streets	5.65	4.26	(1.39)	0.92	0.72	(0.19)	0.63	0.51	(0.12)
East Boston									
Highways and Ramps	1.80	1.63	(0.17)	0.30	0.33	0.03	0.28	0.33	0.04
Local Streets	3.88	2.04	(1.84)	0.61	0.31	(0.30)	0.43	0.23	(0.20)
East Cambridge									
Highways and Ramps	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Local Streets	7.92	5.71	(2.22)	1.46	0.97	(0.49)	0.79	0.64	(0.15)
Totals	48.86	38.00	(10.87)	8.28	6.67	(1.60)	5.81	5.35	(0.47)

1. Change = the difference in emissions with/without the project

Source: Bechtel/Parsons Brinckerhoff

Table 4.21

ANNUAL EMISSION BURDENS IN THE STUDY AREA
(tons per year)
2010

Affected Zone	CO Without The Project	CO Proposed Action	CO Change[1]	HC Without The Project	HC Proposed Action	HC Change[1]	NO_x Without The Project	NO_x Proposed Action	NO_x Change[1]
Area North of Causeway									
Highways and Ramps	1,266	1,177	(89)	212	229	17	197	221	24
Local Streets	1,161	815	(346)	196	125	(71)	134	102	(31)
Central Area									
Highways and Ramps	2,286	1,498	(787)	341	282	(59)	299	269	(30)
Local Streets	2,914	2,008	(906)	529	334	(195)	289	225	(64)
I-93/I-90 Interchange									
Highways and Ramps	844	873	29	155	166	11	148	159	11
Local Streets	1,327	1,341	14	217	225	7	154	153	(1)
South Boston									
Highways and Ramps	0	348	348	0	78	78	0	77	77
Local Streets	1,870	1,412	(459)	303	239	(64)	210	169	(41)
East Boston									
Highways and Ramps	595	540	(55)	101	110	10	93	108	14
Local Streets	1,285	675	(610)	202	101	(101)	142	77	(65)
East Cambridge									
Highways and Ramps	0	0	0	0	0	0	0	0	0
Local Streets	2,622	1,889	(733)	484	322	(161)	261	213	(48)
Totals	16,170	12,576	(3,634)	2,740	2,211	(528)	1,927	1,773	(154)

1. Change = the difference in emissions with/without the project

Source: Bechtel/Parsons Brinckerhoff

Of these totals, approximately 69 percent of the CO, 71 percent of the HC, and 62 percent of the NO_x were emitted from motor vehicles using local streets without the Artery/Tunnel Project, and approximately 70 percent of the CO, 61 percent of the HC, and 53 percent of the NO_x were emitted from motor vehicles using local streets with the Artery/Tunnel Project.

These results indicate that there will be a net decrease (improvement) in the total amount of CO, HC and NO_x emissions from motor vehicles using the study area roadway network with the Artery/Tunnel Project both compared to existing (1987) conditions, and conditions in the year 2010 without the project. The results of this analyses also indicate that, with the Artery/Tunnel Project, there will be a net decrease (improvement) in the percentage of CO, HC, and NO_x emissions from motor vehicles using local streets in the study area roadway network in the project design year (2010).

Overall, compared with the 2010 future no-action condition, the project will result in a 22 percent reduction in CO, a 19 percent reduction in HC, and an 8 percent reduction in NO_x emissions.

4.7 CARBON MONOXIDE LEVELS IN THE VICINITY OF TOLL PLAZAS

CO levels in the vicinity of the existing and proposed toll plazas in East Boston were estimated using the same approach used for the intersection analysis. CO concentrations were estimated at six locations in the vicinity of the existing toll plaza and three locations in the vicinity of the proposed toll plaza.

The results of the analysis indicate that maximum 8-hour CO concentrations in the vicinity of the existing toll plaza will be approximately 11.5 ppm (i.e., greater than the AAQS) in 1987, 3.7 ppm in 1998, and 3.8 ppm (i.e., less than the AAQS) in 2010 with the Proposed Action. CO levels at the proposed toll plaza in 2010 (3.2 ppm) are estimated to be less than half of the 8-hour AAQS for CO for both years of analysis (1998 and 2010).

4.8 CARBON MONOXIDE CONCENTRATIONS IN PROPOSED TUNNELS

4.8.1 Ventilation Criteria

The tunnel portions of the Artery/Tunnel Project have been analyzed and will be designed in accordance with FHWA and recently adjusted EPA guidance (February 23, 1989). This guidance provides that:

- o CO concentrations within the tunnel will not exceed an average of 120 parts per million (ppm) for an exposure period of up to 15 minutes under peak traffic conditions.

- o A program be developed to minimize exposure of the public to high levels of CO during in-tunnel traffic congestion incidents which last longer than 15 minutes.

These criteria will be achieved with a ventilation system design providing necessary amounts of supply air to maintain CO concentration at acceptable levels under traffic breakdown

conditions. In addition, a traffic management system will be provided to detect and respond quickly to traffic breakdowns with a series of predetermined actions to assure the health and welfare of motorists using the tunnel.

4.8.2 Tunnel Design

Tunnels will be ventilated using a full-transverse ventilation system: a supply and exhaust ventilation system proven to be effective in numerous similar applications throughout North America. The system will be designed on the basis of peak hour and average weekday traffic projections for the design year 2010. In-tunnel concentrations of CO will be measured continuously using a series of automatic monitors.

Traffic flows will be monitored through a traffic surveillance and control system which will identify a traffic incident within the tunnels through the use of a series of sequential automatic traffic volume detectors and closed circuit television cameras. CO levels and traffic flows will be monitored at an operations control center.

Once an incident is detected, ventilation air flow rates will be adjusted automatically to maintain safe in-tunnel air quality levels, emergency vehicles will be dispatched to the scene of the incident, directions will be given to motorists through the use of variable message signs, and necessary measures will be taken to clear the tunnel or to control traffic flows entering the tunnel.

4.9 TUNNEL VENTILATION SYSTEM

4.9.1 Introduction

The tunnel sections of the Artery/Tunnel Project will be ventilated through a ventilation system designed to meet FHWA and EPA requirements for highway tunnels. The ventilation system planned for the project would duct fresh air to the tunnel from fans housed in a series of ventilation buildings located along the tunnel alignment. Exhaust air would be drawn through ports in the tunnel ceiling by fans located within the ventilation buildings, and discharged to the atmosphere through exhaust ducts at the top of the ventilation buildings. The ventilation buildings will be designed and located so that they will:

- protect public health and safety
- minimize any potential for adverse air quality concentrations
- minimize any potential for adverse effects on cultural resources, parklands, recreational resources, and wildlife refuges
- avoid displacement of residences and costly or specialized facilities vital to the community

A study was performed to screen potential sites and locate required ventilation buildings. The study addressed the need for and types of ventilation systems and buildings, the engineering, environmental and other constraints to siting ventilation buildings, the

availability of sites along the project alignment, and other economic considerations. Provided below is a summary of the process used to determine the ventilation system, including the number and locations of ventilation buildings.

4.9.2 Ventilation Requirements And Design Constraints

The ventilation system for the tunnel sections of the Artery/Tunnel Project must provide for safe in-tunnel air quality levels during normal operating conditions, and for control of smoke and heat in the event of in-tunnel fires. Ventilation during normal operation is required because motor vehicles emit air pollutants which have been shown to have adverse effects on human health in sufficiently high concentrations. In-tunnel fires could produce large quantities of smoke and intense heat -- an acute hazard to the health and safety of motorists using the tunnel. In such an event, the ventilation system must (and will) assist in controlling smoke during emergencies to permit the safe evacuation of motorists present in the tunnel. In addition, the Artery/Tunnel Project must (and will) meet in-tunnel air quality criteria established by FHWA and EPA to protect the health and safety of motorists travelling through vehicular tunnels, and discharges of pollutants from exhaust ducts of tunnel ventilation buildings must (and will) not result in violations of AAQS set by EPA and the Commonwealth of Massachusetts.

Each tunnel segment could be served by a single or multiple ventilation buildings. In general, as the number of ventilation buildings increases:

- o tunnel ducts must move smaller volumes of air and can be made smaller, leading to lower construction costs, and less disruption of existing underground facilities
- o ventilation buildings can be somewhat smaller
- o there may be somewhat better initial dispersion of exhaust air, depending on the locations of the ventilation buildings.

However, a multiple ventilation building system, particularly a system with more than two buildings, generally results in:

- o a larger number of affected parcels, buildings, and land uses
- o a greater number of areas that may experience higher levels of contaminants
- o greater total ventilation building construction costs
- o a complex system, more difficult and costly to maintain and operate reliably than single building system

Prior to performing studies of the ventilation system and a site screening analysis, constraints to the placement of tunnel ventilation ducts and buildings have been identified to determine the independent tunnel segments requiring ventilation. Identified constraints included:

- o Central Area: the crossing of the MBTA Blue Line subway tunnel effectively divides the Central Area into two sectors -- State Street to Causeway Street and State Street

to the northern portal of the existing Dewey Square tunnel for the southbound portion of the roadway, and to Summer Street where the tunnel passes under the MBTA Red Line at South Station for the northbound portion of the roadway.

- o South Bay/Fort Point Channel: The northbound portion of the roadway from just south of the I-93/I-90 Interchange to the Summer Street Red Line crossing and the eastern extension of I-90 across the Fort Point Channel to the vicinity of "A" Street effectively define separate ventilation systems for these portions of the Proposed Action.

- o South Boston/Harbor Tunnel/Logan Airport area: At least two independent ventilation systems would be required for these portions of the roadway. One system would serve the tunnel section extending from the vicinity of "A" Street to the portal in the vicinity of "D" Street. A second system would serve the tunnel section between the Northern Avenue portal and the new East Boston toll plaza.

4.9.3 Candidate Site Screening And Selection Process

Potential ventilation building sites have been identified for each tunnel section. Optimally, ventilation buildings should be located above or within a short distance from the tunnel section to be ventilated. Ventilation buildings cannot be placed in conflict with future at-grade roadways, or directly beneath the existing Central Artery viaduct due to the sequence and complexities of the proposed construction work.

Based on conceptual ventilation building layouts, 199 parcels have been identified as potential sites for ventilation buildings within approximately 300 feet of the proposed alignment. Beyond this distance, the size and cost of fans and connecting ductwork, the amount of energy consumed, and the disruption of buildings, uses, and utilities on intervening parcels becomes prohibitive.

Each site was screened on the basis of eight feasibility criteria:

- o Site Size - at least 20,000 square feet are required

- o Site Configuration - minimum site dimension of 80 feet is required

- o Displacement of Residential Land Uses - total avoidance of any unnecessary displacements (in keeping with longstanding commitments reflected in the FEIS/R)

- o Displacement of Major Facilities - total avoidance of displacement for environmental and economic feasibility reasons

- o Impact on Historic Resources and Parklands - avoidance of significant impacts (consistent with federal and state protections of such properties)

- o Need for Fill in Water - total avoidance if possible (consistent with applicable federal and state regulations)

- o Compatibility with Construction Staging - site location and availability must be consistent with construction plans and otherwise feasible

- o Constraints due to existing Major Subsurface Obstructions - avoidance of conflicts

A total of 124 sites did not meet these minimum feasibility thresholds and have been eliminated as candidate sites. Most of these sites were on the I-93 corridor and have been dropped due to inadequate size, potential impacts on historic resources, or placement of fill in Boston Harbor.

The 75 remaining sites have been evaluated further to identify those sites which would require extraordinarily difficult and costly construction work. While a ventilation building could conceivably be designed for any of these sites, a total of 19 have been eliminated from further study based on one or both of the following considerations:

- o Sites of irregular configuration would inhibit a practicable building design, potentially require placement of equipment in more than one building, and diminish system operating efficiency.

- o Sites located at the end of a tunnel section would require substantially larger ducts, a larger building, and more major equipment than would sites located near the midpoint or "quarter" points of the tunnel section. This would result in greater environmental impacts, construction costs, design difficulties, increased power requirements, and disruption of existing utilities.

Of the 56 remaining sites, several others have been eliminated from further consideration because of their proximity to residences or other sensitive land uses. Some were occupied by recently constructed buildings, or under development. Use of others was constrained by social or economic factors. Further study was therefore undertaken to evaluate the comparative desirability of constructing ventilation buildings at the remaining sites.

4.9.4 Comparative Evaluation Of Potential Ventilation Building Sites

The 56 remaining ventilation building sites were evaluated on the basis of 12 parameters:

- o Air Quality Impacts
- o Noise Impacts
- o Vibration Impacts
- o Impact on Coastal Resources
- o FAA Height Limitations
- o Cost
- o Site Ownership
- o Impact on Site Use/Development
- o Impact on Historic Resources
- o Impact on Archaeological
- o Visual Compatibility
- o Subsurface Constraints

These parameters have been used to define whether a ventilation building would cause minor, moderate, or major impacts on sensitive resources; or whether specific features of a site would pose minor, moderate, or major constraints to development of a ventilation system.

4.9.5 Ventilation System Design Concepts

Various ventilation systems design concepts, employing one or two ventilation buildings, have been considered for ventilating each tunnel sector. These concepts have been developed to a level of detail sufficient to make order-of-magnitude estimates of the length of required ducting, the number and sizes of fans, the dimensions of the ventilation buildings, the locations of exhaust air ducts, and costs.

In general, where one ventilation building has been considered, it was located on a site close to the midpoint of the ventilation sector. In two-building systems, each building was located on sites at or near the quarter-points of the ventilation sector. A total of 25 alternative ventilation systems have been developed and evaluated.

4.9.6 Proposed Ventilation System Design

Based on the site screening and selection evaluation, the following systems are proposed:

State Street To Causeway Street. One ventilation building on Parcel 7 (see Figure 4.4) is proposed for this tunnel sector. This option would be substantially less expensive than a two-building option, and would result in fewer potential impacts on historic and residential areas than other ventilation system design concepts.

Dewey Square To State Street. One ventilation building on the Boston Edison site on Atlantic Avenue is proposed for this tunnel sector. Although construction costs were virtually the same for the options studied, and the ratings for the screening parameters were similar among the options, a single-building system would minimize design and operating costs, and reduce required duct connections, compared to other options evaluated.

I-93/I-90 Interchange. Individual single building systems are proposed for ventilating I-93 and I-90 in this sector. One-building options would be less expensive than two-building systems, and would have fewer potential impacts on the Leather District Historic District.

A Street To D Street In South Boston. A one-building system is proposed for this tunnel sector. This option would result in fewer environmental impacts, and be more cost effective than a two building system.

Northern Avenue To Logan Airport. A two-building system, with buildings on the Subaru Pier and Bird Island Flats, is the preferred option for this tunnel sector primarily under Boston Harbor and Logan Airport.

In summary, one-building systems are recommended for all tunnel sectors, with the exception of the section between Northern Avenue and Logan Airport, which would have two buildings at the quarter-points. (Proposed ventilation building sites are identified on Figure 4.4 and Table 4.22.)

4.10 AIR QUALITY IMPACTS OF VENTILATION BUILDINGS

Studies have been undertaken to provide that the automotive exhausts passing through the

Table 4.22

PROPOSED VENTILATION BUILDING SITES

Number	Location
1	Near Fort Point Channel (I-90)
2	Near I-93/I-90 Interchange (I-93 northbound)
3	Boston Edison Substation (I-93)
4	Parcel 7 (I-93)
5	Commonwealth Flats (I-90)
6	Subaru Pier (I-90)
7	Bird Island Flats (I-90)

Source: Bechtel/Parsons Brinckerhoff

ventilation system will not result in localized increases in NO_x and CO concentrations downwind of the ventilation buildings that will cause violations of ambient air quality standards. This section describes the results of analytical and wind tunnel studies completed to evaluate the potential impact of NO_x and CO emissions passing through the seven proposed ventilation buildings. The results of these analyses are compared with applicable National and Massachusetts AAQS and DEP policy guidelines.

4.10.1 Emissions From Ventilation Buildings

4.10.1(a) Carbon Monoxide Emissions Estimates

The total amount of CO in the atmosphere resulting from the vehicular operation on a highway and tunnel project is the sum of two components:

- CO emitted directly from motor vehicles using the roadways
- Background CO levels present in the atmosphere from other sources

CO emissions passing through each of the ventilation buildings were estimated for the estimated year of project completion (1998) and the project design year (2010) using the most recent version of EPA's mobile source emission factor program (MOBILE 4) based on estimated peak 1-hour and peak 8-hour average traffic conditions. (Estimated CO emission rates are provided in Table 4.23.)

4.10.1(b) Nitrogen Oxides Emissions Estimates

NO_x emissions passing through each of the ventilation buildings were also estimated for the two specified years (1998 and 2010) using the MOBILE 4 emission factor program based on estimated peak 1-hour and 8-hour average traffic conditions. These values are also provided in Table 4.23.

4.10.2 Air Quality Modeling Procedures

The impacts of CO and NO_x emissions were estimated using analytical modeling and physical modeling techniques. The impacts of five of the seven ventilation buildings (Numbers 1, 2, 5, 6, and 7; see Figure 4.4) were evaluated using analytical modeling only. These buildings are located in areas relatively free of tall buildings, i.e., in areas appropriate for the use of analytical dispersion modeling techniques. The two remaining ventilation buildings (Numbers 3 and 4, to be located on the Boston Edison and Parcel 7 sites, respectively) would be located among numerous tall and massive structures in downtown Boston. These types of surrounding structures produce intricate air flow patterns and wind turbulence that make additional study appropriate, particularly over short time periods. Therefore, short-term (1-hour) NO_2 concentrations in the vicinity of those two sites were estimated using physical modeling techniques. Long-term (annual average) NO_2 concentrations were estimated using analytical modeling techniques for all seven ventilation buildings.

Short-term (1-hour and 8-hour) CO concentrations were estimated using analytical techniques for all seven ventilation buildings. Analytical models are more suited to predict longer term concentrations (i.e., greater than 1-hour) than physical modeling. For instance, concentrations measured by physical modeling have to be extrapolated to longer averaging time periods through the use of generic or site-specific time conversion factors while

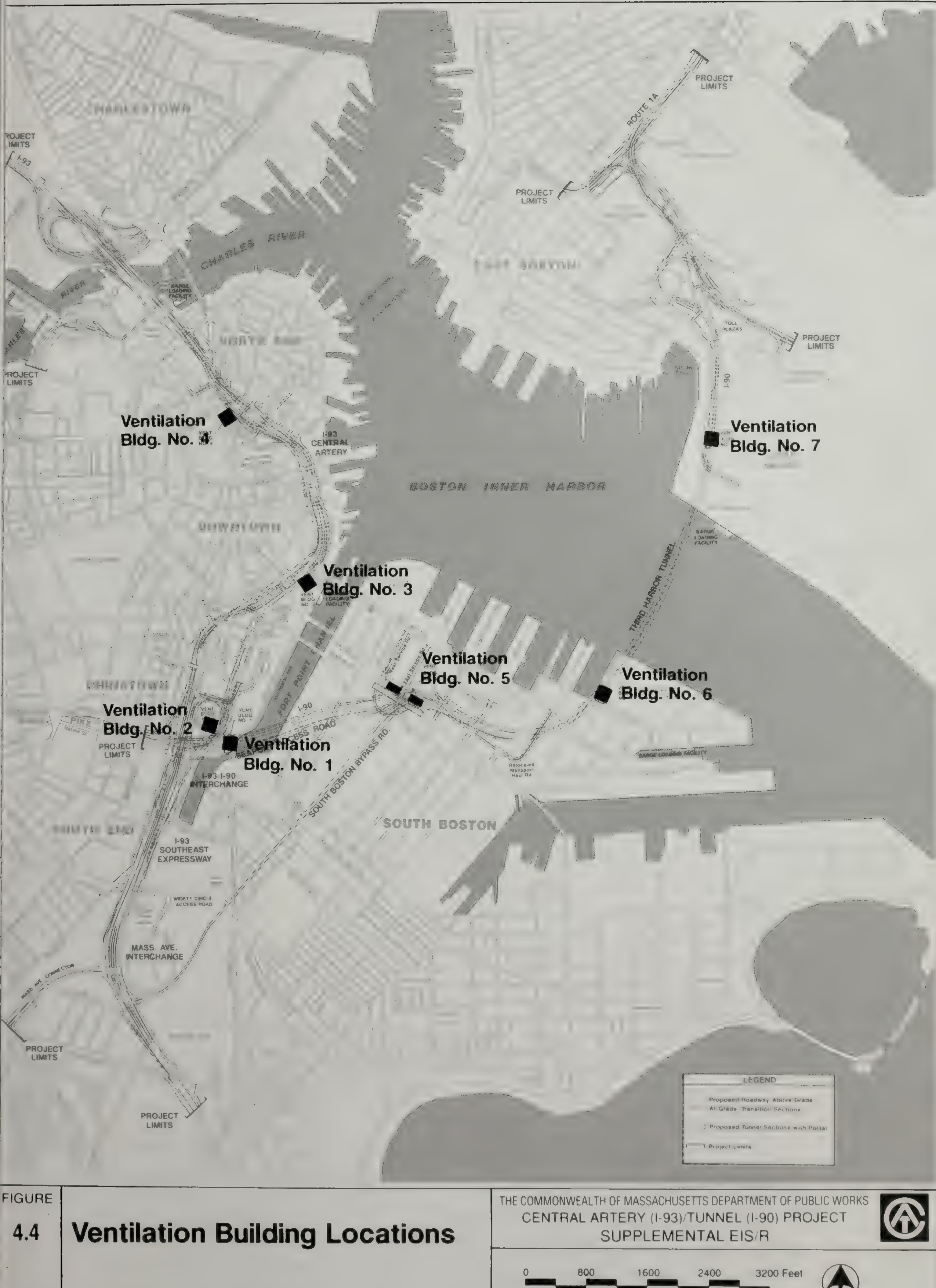

FIGURE 4.4

Ventilation Building Locations

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

Table 4.23

EMISSION RATES USED IN VENTILATION BUILDING IMPACT ANALYSIS (grams/sec)

Building		CO		NO_x	
No.	Location	Peak Hour	Peak 8-Hour	Peak Hour	Peak 8-Hour
			1998		
1	Near Fort Point Channel	6.463	4.688	0.812	0.650
2	Near I-93/I-90 Interchange	8.173	5.182	0.775	0.548
3	Boston Edison Site	19.809	12.353	2.232	1.706
4	Parcel 7 Site	25.592	16.909	2.839	2.192
5	Commonwealth Flats	8.549	6.535	1.002	1.413
6	Subaru Pier	7.620	5.754	0.921	0.804
7	Bird Island Flats	13.151	10.284	1.441	1.280
			2010		
1	Near Fort Point Channel	6.211	4.499	0.728	0.580
2	Near I-93/I-90 Interchange	7.721	4.977	0.698	0.492
3	Boston Edison Site	18.514	11.818	2.003	1.522
4	Parcel 7 Site	24.571	16.230	2.563	1.962
5	Commonwealth Flats	8.216	6.275	0.899	0.759
6	Subaru Pier	7.322	5.524	0.829	0.718
7	Bird Island Flats	12.615	9.856	1.296	1.149

Source: Bechtel/Parsons Brinckerhoff

analytical modeling can use hourly meteorological data collected at a site representative of an area directly to predict longer time concentrations. Since mobile sources were analyzed for CO through the use of analytical models, and since the 8-hour CO values are important with respect to showing compliance with the AAQS, the CO impacts due to automotive exhaust emissions passing through the ventilation building emissions were also analyzed through such models to ensure consistency in approach.

4.10.2(a) Description Of Analytic Modeling Procedures

Analytic modeling was completed using the EPA Industrial Source Complex (ISC) Air Quality Dispersion Model [EPA, "Industrial Source Complex (ISC) Dispersion Model User's Guide," Second Edition (Revised), Volume 1, EPA-450/4-88-002a, Office of Air Quality Planning and Standards, Research Triangle Park, NC, December 1987] to estimate CO and NO_2 levels in the vicinity of each of the seven proposed ventilation buildings. The ISC Model combines and enhances various dispersion model algorithms into a set of two computer programs (the ISC short-term model and the ISC long-term model) that can be used to assess air quality impact.

The ISC short-term (ISCST) model is an extended version of the Single Source (CRSTER) Model [EPA, "User's Manual for Single Source (CRSTER) Model," EPA-450/2-77-013, Research Triangle Park, NC, 1977]. It is designed to calculate concentrations of air pollutants for time periods ranging from 1 to 24 hours, at ground-level or elevated (i.e., flagpole) receptors. The ISC long-term (ISCLT) model is a sector-averaged model that extends and combines basic features of two other air quality models: the Air Quality Display Model (AQDM) and the Climatological Dispersion Model (CDM). The ISCLT Model uses statistical wind summaries to calculate annual ground-level concentrations of air pollutants.

Both the short-term and long-term versions of the ISC Model apply the steady-state Gaussian plume equation for a continuous source. The generalized Briggs plume-rise equations are used to calculate plume rise as a function of downwind distance. Procedures suggested by Huber and Snyder and Schulman-Scire are used to evaluate the effects of aerodynamic wakes and eddies formed by buildings and other structures of plume dispersion. The Pasquill-Gifford curves are used to calculate lateral and vertical plume spread. Separate algorithms are incorporated for the calculation of urban mixing heights and dispersion coefficients.

Major inputs to the ISCST Model include:

- o Meteorological data, including hourly estimates of wind direction, wind speed, ambient air temperature, Pasquill stability category, mixing height, wind-profile exponent and vertical temperature gradient

- o Source data, including source location and elevation, pollutant emission rate, physical emission height, effective diameter of exhaust duct, exhaust gas temperature and exit velocity, and the length, width, and height of the ventilation buildings which could potentially produce aerodynamic wake effects

- o Receptor data, including receptor location and height

Major inputs to the ISCLT Model are similar to those for the ISCST Model, except that the principal meteorological input is annual "STAR" summaries of meteorological data. (STAR

Table 4.24

AIR QUALITY PREDICTION SITES FOR PHYSICAL MODELING OF VENTILATION BUILDING 3: BOSTON EDISON SITE

No.	Site ID	Description	Height Above Grade (ft.)	Distance From Ventilation Building (ft.)
1	A1	Harbor Towers (plume height)	240	1250
2	A2	Harbor Towers (pool)	0	1175
3	A3	Boston Harbor Hotel	167	760
4	A4	U.S. Custom House	0	390
5	A5	Rowes Wharf	89	1075
6	A6	U.S. Custom House (roof)	140	450
7	A7	470 Atlantic Avenue (roof)	191	0
8	B1	Northern Avenue/Sleeper Street	0	840
9	B2	Victoria Station Restaurant	0	760
10	B3	Farnsworth Street	0	1250
11	B4	Southeast 600 meters	0	1970
12	B5	Children's Museum	0	920
13	B6	Congress Street	0	1400
14	B7	Boston Tea Party Museum	0	640
15	B8	South (Necco Street) 600 meters	0	1970
16	C1	Congress Street/Dorchester Avenue	0	710
17	C2	Dorchester Avenue/Summer Street	0	1025
18	C3	Stone & Webster Building	226	1140
19	C4	One Financial Center (roof)	610	1535
20	C5	Federal Reserve Fresh Air Intake #3	538	920
21	C6	Stearns Perry & Smith Co.	100	440
22	C7	South Station	93	1225
23	C8	Federal Reserve Fresh Air Intake #2	98	960
24	C9	South Station	0	1200
25	C10	One Financial Center	0	1250
26	C11	Federal Reserve	0	630
27	C12	Keystone Building (fresh air intake)	192	775
28	C13	Keystone Building	0	780
29	D1	Building between High Street and Matthews	412	970
30	D2	Western Union Building	187	640
31	D3	Road House	40	600
32	D4	125 High Street Building	226	630

Table 4.24 (Cont.)

AIR QUALITY PREDICTION SITES FOR PHYSICAL MODELING OF VENTILATION BUILDING 3: BOSTON EDISON SITE

No.	Site ID	Description	Height Above Grade (ft.)	Distance From Ventilation Building (ft.)
33	D5	New England Telephone	365	1,075
34	D6	New Fire House	24	450
35	D7	State Street Bank Building	443	900
36	D8	Northwest (Milk Street)	0	1,550
37	D9	Oliver/Franklin Streets	0	1,125
38	D10	21-story Tower	230	650
39	D11	Oliver/High Streets	0	850
40	D12	Shops on Purchase/Oliver Streets	71	450
41	D13	International Place	0	510
42	D14	International Place (fresh air intake)	42	600
43	D15	North (Atlantic Avenue)	0	1,970
44	D16	Building on Broad/High Streets (roof)	82	975
45	D17	Building on India/Milk Streets (roof)	164	1,625

1. Site B4 is located beyond the boundaries of Figure 4.5

Source: Bechtel/Parsons Brinckerhoff

Table 4.25

AIR QUALITY PREDICTION SITES FOR PHYSICAL MODELING OF VENTILATION BUILDING 4: PARCEL 7

No.	Site Label	Description	Height Above Grade (ft.)	Distance From Ventilation Building (ft.)
1	R1	Boston City Hall	120	520
2	R1A	Boston City Hall	0	915
3	R2	Hanover Street Building	55	175
4	R3	Hanover Street Building	36	165
5	R4	Proposed Buildings at Existing Elevated Highway	55	340
6	R6	New Federal Building	69	315
7	R7	Government Center Garage	107	350
8	R8	JFK Federal Building	355	815
9	R9	Creek Square Building	74	505
10	A1	Blackstone Street	0	100
11	A2	St. Mary's School	0	765
12	A4	Boston Policy Academy	0	750
13	A5	Hanover Street	0	900
14	A6	C.C. Youth Center	19	1080
15	A8	Basketball Court	0	600
16	A9	Prince Street	0	1220
17	A10	Callahan Tunnel Building	54	1165
18	A11	Future Park	0	405
19	A12	North Street	0	850
20	A13	Commercial Street	0	1450
21	B1	Marshall Street	0	100
22	B2	Congress Street Building	0	890
23	B3	Congress Street	0	1420
24	B4	Faneuil Flower Market	0	690
25	B5	State Street Building	0	1205
26	B6	Parking Garage	0	635
27	B7	New England Telephone	0	1750
28	B8	Play Area	0	1680
29	B9	Union Street	0	175
30	B10	Mercantile Mall	0	1190
31	C1	Pool	0	830
32	C2	New Federal Building	0	300
33	D1	Canal Street	0	750
34	D2	Portland Street	0	810
35	D3	State Service Center	0	1375
36	D4	Washington Street	0	1070

Table 4.25 (Cont.)

AIR QUALITY PREDICTION SITES FOR PHYSICAL MODELING OF VENTILATION BUILDING 4: PARCEL 7

No.	Site Label	Description	Height Above Grade (ft.)	Distance From Ventilation Building (ft.)
37	D5	Ventilation Building-Bottom Level Air Intake	0	225
38	D6	Ventilation Building-Upper Level Air Intake	75	225
39	D7	Canal/Causeway Streets	0	1550
40	D8	Market Street	0	705
41	D9	Sudbury Street	0	280
42	S1	North 600 meters	0	1970
43	S2	Northeast 600 meters	0	1970
44	S3	East-Northeast 600 meters	0	1970
45	E3	New Boston Garden	0	1700
46	E4	New Boston Garden	400	1700
47	E2	North Market Street	0	910
48	E1	Richmond/Fulton Streets	0	1150

1. Sites S1, S2, and S3 are located beyond the boundaries of Figure 4.6

Source: Bechtel/Parsons Brinckerhoff

summaries are statistical tabulations of the joint frequency of occurrence of wind-speed and wind-direction, classified according to the Pasquill stability categories.)

The ISC Model has been approved by EPA and DEP for this analysis for estimating ambient air quality levels as a result of automotive exhaust passing through the ventilation systems.

4.10.2(b) Description Of Physical Modeling Procedures
Physical modeling was performed at the Colorado State University wind tunnel facility to determine NO_x levels at 45 locations in the vicinity of the Boston Edison Site, and 48 locations in the vicinity of the Parcel 7 site (see Tables 4.24 and 4.25, and Figures 4.5 and 4.6, respectively). Physical modeling was completed by constructing a 1:384 reduced physical scale model of the proposed ventilation buildings and other major structures in downtown Boston within a 2,300-foot radius of the buildings; placing the model in a wind tunnel with an appropriate upwind roughness of each site; injecting first smoke, and then metered mixtures of tracer gas of known concentrations into the wind tunnel through the exhaust ducts of the scale model of the ventilation buildings; varying the angle and velocity profiles of the wind blown over the scale model to simulate a spectrum of dispersion conditions and exhaust flow rates; observing and videotaping the manner in which smoke from the exhaust ducts is blown over the model to determine areas of maximum potential impact and areas of potential stack or building downwash, cavity mixing, plume descent, plume lofting, and building impingement; collecting samples of tracer gas at multiple points surrounding the proposed ventilation buildings, including areas of maximum potential impact and sites of fresh air intakes of nearby buildings; analyzing the collected samples; and scaling of results to simulate actual, full-scale conditions.

4.10.2(c) Conversion Of NO_x To NO_2
In order to directly compare the predicted air quality concentrations against National and Massachusetts AAQS and DEP policy guideline levels, estimated NO_x concentrations were converted to equivalent NO_2 concentrations, as described in the following discussion.

Most of the NO_x emitted by motor vehicles is in the form of nitrogen oxide (NO). NO is then converted to NO_2 in the atmosphere through a series of reactions with photochemical oxidants. The total amount of NO_2 in the atmosphere passing through a ventilation building is, therefore, the sum of three components:

- o NO_2 emitted directly from motor vehicles
- o NO_2 formed through the oxidation of NO emitted from motor vehicles
- o Background levels of NO_2 present in the atmosphere from other sources

The amount of NO converted to NO_2 was estimated using the "ozone limiting method," a procedure approved for use in this study by EPA and Massachusetts DEP. This methodology is based on the assumption that NO is converted to NO_2 by the reaction of NO with ozone, and that the extent of this reaction is limited by the amount of ozone present in the atmosphere. Its applicability is limited to distances less than 20 kilometers from a source of NO_x, since, at greater distances, complex photochemical reactions involving compounds in addition to ozone would invalidate the assumption that the formation of NO_2 is limited by the amount of ozone present in the atmosphere. All estimates using the ozone limiting method were made for distances less than 20 kilometers from the ventilation buildings.

Based on coordination with DEP, the overall ratio of NO_2 to NO_x in the atmosphere surrounding the ventilation buildings was assumed to be 0.81. This assumed value corresponds to ratios reported in the technical literature (Hegg, *et al.*), and is consistent with the upper limit of NO_2/NO_x ratios monitored at the Orient Heights air quality monitoring station in the Boston region.

A small portion of the NO_x emitted from motor vehicles is in the form of nitrogen dioxide. Based on an assumed travel average speed of 25 miles per hour, it is estimated that the ratio of NO_2/NO_x in the exhaust from motor vehicles using the project tunnels is approximately 0.05. Since the overall ratio of NO_2 to NO_x in the atmosphere is approximately 0.81, it is estimated that the fraction of NO in motor vehicle exhaust converted to NO_2 is 0.76. These ratios were used in applying the ozone limiting method.

4.10.3 Background Concentrations

Modeling was used to predict incremental air pollutant concentrations which would result from the vehicular emissions being analyzed. To estimate total concentrations at a given location, background concentrations were added to the modeled values to account for the effects of emissions from other sources. Background levels were determined based on available monitoring data. The background values used were 62.0 ug/m^3 for annual NO_2, 5 ppm for 1-hour CO, and 3 ppm for 8-hour CO levels. One-hour NO_2 background levels varied based on assumed wind directions. No adjustment was made to reflect the expected reduction in background concentrations as a result of reduced vehicular emissions of these pollutants in the future.

4.10.4 Results Of Analysis Of Automotive Exhaust Passing Through Ventilation Buildings

Total concentrations, which are the sums of estimated incremental concentrations at a given location and corresponding background values, are presented in this section. These results are compared to the applicable standards shown in Table 4.1 to demonstrate air quality compliance. Since the short-term air quality standards are not to be exceeded more than once a year per site, the highest second-highest estimated concentration was utilized to demonstrate air quality compliance.

Provided in Table 4.26 are estimates of maximum annual NO_2 concentrations which are expected to occur at ground level and elevated receptor locations in the vicinity of each ventilation building, based on the results of analytic modeling. ("Elevated" receptors include the location of fresh air intakes for buildings and other locations along the facades or on the roofs of structures in the vicinity of each proposed ventilation building.) The estimated maximum annual concentrations of NO_2 are based on a conservative assumption of complete conversion (100 percent) of NO_X to NO_2. The results of this analysis indicate that there would be no violation of the National AAQS or Massachusetts DEP policy guidelines for NO_2 as a consequence of emissions from any ventilation building, during either the estimated year of project completion (1998) or the project design year (2010).

Table 4.27 provides estimates of maximum 1-hour and 8-hour CO concentrations which are expected to occur at ground level and elevated receptor locations in the vicinity of each

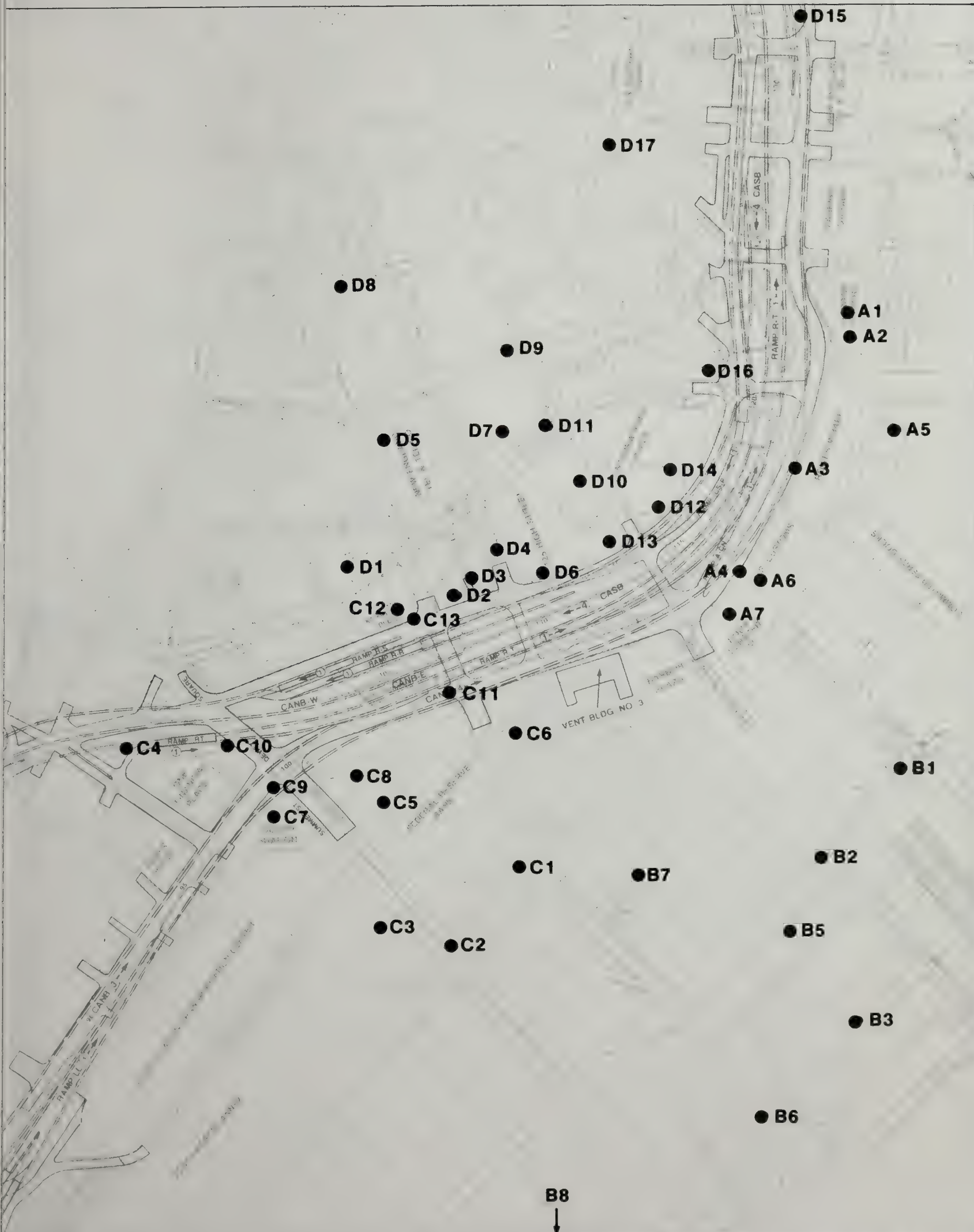

FIGURE 4.5

Location Of Receptor Sites For Vent Bldg. No. 3 (Boston Edison) Wind Tunnel Study

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

0 100 200 400 800
FEET

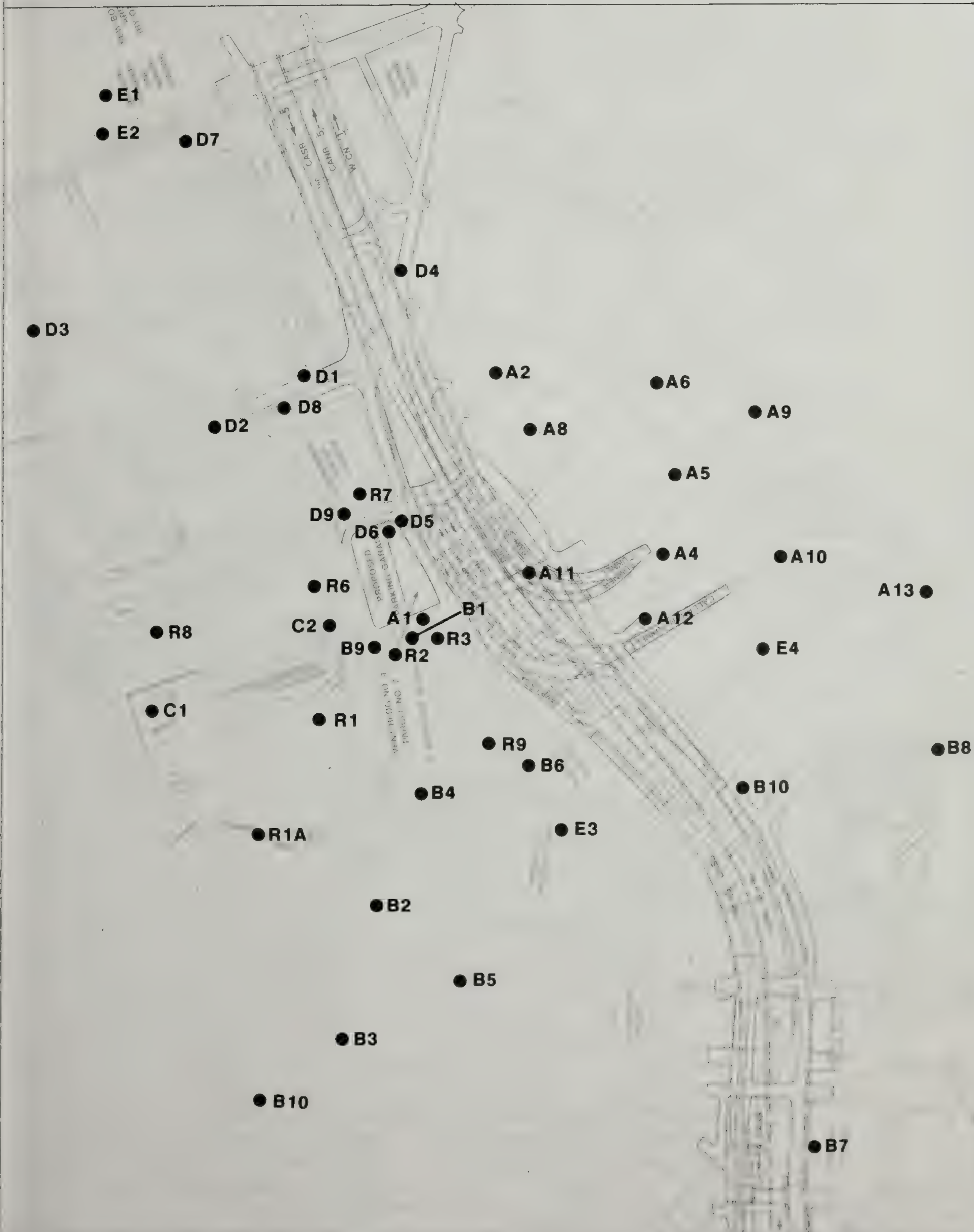

FIGURE 4.6

Location Of Receptor Sites For Vent Bldg. No. 4 (Parcel 7) Wind Tunnel Study

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

Table 4.26

MAXIMUM ANNUAL AVERAGE NO_2 CONCENTRATIONS AT GROUND LEVEL AND ELEVATED RECEPTOR LOCATIONS IN THE VICINITY OF PROPOSED VENTILATION BUILDINGS BASED ON ANALYTICAL (ISCLT) MODELING RESULTS

Ventilation Building		Maximum Ground Level Concentrations		Maximum Elevated Receptor Concentrations	
Number	Location	Concentration (ug/m^3)	Distance Downwind of Vent Bldg (m)	Concentration (ug/m^3)	Location
YEAR 1998					
1	Near Fort Point Channel	62.9	100	62.7	Wang Building Roof Fresh Air Intake
2	Near I-93/I-90 Interchange	62.8	100	63.6	Wang Building Roof Fresh Air Intake
3	Boston Edison	62.8	200	65.1	125 High Street Building
4	Parcel 7	66.1	100	72.0	Creek Square Building
5	Commonwealth Flats	64.7	100	--	N/A
6	Near Subaru Pier	63.4	100	--	N/A
7	Near Bird Island Flats	65.4	100	--	N/A
YEAR 2010					
1	Near Fort Point Channel	62.8	100	62.6	Wang Building Roof Fresh Air Intake
2	Near I-93/I-90 Interchange	62.8	100	63.4	Wang Building Roof Fresh Air Intake
3	Boston Edison	62.7	200	64.1	125 High Street Building
4	Parcel 7	65.7	100	68.9	Creek Square Building
5	Commonwealth Flats	63.3	100	--	N/A
6	Near Subaru Pier	63.2	100	--	N/A
7	Near Bird Island Flats	65.0	100	--	N/A

1. Maximum concentration estimates based on 100 percent conversion of NO_x to NO_2
2. N/A: Not applicable; no relevant elevated receptor locations
3. All values include NO_2 background level of 62 ug/m^3
4. National and State AAQS for NO_2 = 100 ug/m^3

Source: Bechtel/Parsons Brinckerhoff

Table 4.27

MAXIMUM 1-HOUR AND 8-HOUR CO CONCENTRATIONS AT GROUND LEVEL AND ELEVATED RECEPTOR LOCATIONS IN THE VICINITY OF PROPOSED VENTILATION BUILDINGS BASED ON ANALYTICAL (ISCST) MODELING RESULTS

Ventilation Building		Maximum Ground Level Concentrations (ppm)		Maximum Elevated Receptor Concentrations (ppm)		
Number	Location	1-Hour[1]	8-Hour[2]	Location	1-Hour[1]	8-Hour[2]
		YEAR 1998				
1	Near Fort Point Channel	5.14	3.10	Wang Bldg Fresh Air Intake	5.14	3.10
2	Near I-93/I-90 Interchange	5.17	3.11	Wang Bldg Fresh Air Intake	5.34	3.22
3	Boston Edison	5.11	3.07	125 High St Bldg Roof	7.58	4.61
4	Parcel 7	5.85	3.56	JFK Fed. Bldg Roof	7.61	4.72
5	Commonwealth Flats	5.24	3.18	N/A	N/A	N/A
6	Near Subaru Pier	5.19	3.14	N/A	N/A	N/A
7	Near Bird Island Flats	5.65	3.51	N/A	N/A	N/A
		YEAR 2010				
1	Near Fort Point Channel	5.14	3.10	Wang Bldg Fresh Air Intake	5.14	3.10
2	Near I-93/I-90 Interchange	5.16	3.11	Wang Bldg Fresh Air Intake	5.32	3.21
3	Boston Edison	5.10	3.06	125 High St Bldg Roof	7.41	4.54
4	Parcel 7	5.82	3.54	JFK Fed. Bldg Roof	7.50	4.65
5	Commonwealth Flats	5.23	3.17	N/A	N/A	N/A
6	Near Subaru Pier	5.18	3.14	N/A	N/A	N/A
7	Near Bird Island Flats	5.62	3.49	N/A	N/A	N/A

1. All values include 1-hour CO background level of 5.0 ppm
2. All values include 8-hour CO background level of 3.0 ppm
3. 1-hour CO AAQS = 35 ppm
4. 8-hour CO AAQS = 9 ppm
5. N/A: Not applicable; no relevant elevated receptor locations

Source: Bechtel/Parsons Brinckerhoff

ventilation building, based on the results of analytic modeling. These results indicate that no violation of the National or Massachusetts AAQS for CO will occur as a consequence of emissions passing through any ventilation building for either 1998 or 2010.

Table 4.28 summarizes maximum 1-hour ground level concentrations of NO_x and NO_2 in the vicinity of ventilation buildings 1, 2, 5, 6, and 7. Incremental NO_x concentrations are directly based on the results of analytical modeling. Incremental NO_2 concentrations are based on the application of the ozone limiting method for estimating the atmospheric conversion of NO_x to NO_2. The results indicate that there will be no violation of the 1-hour DEP NO_2 policy level in the vicinity of any of the buildings for either of the years analyzed.

Tables 4.29 and 4.30 summarize maximum 1-hour NO_x concentrations and second-highest 1-hour total NO_2 concentrations in the vicinity of ventilation building 3, Boston Edison, and ventilation building 4, Parcel 7 site, respectively. These values are based on the results of physical modeling and the application of the ozone limiting method. A violation would occur if the designated policy level had been exceeded more than once in the year. The results indicate that there will be no violation of the 1-hour DEP NO_2 policy level in the vicinity of either building.

Tables 4.31 and 4.32 summarize estimates of the maximum predicted NO_2 and CO concentrations based on the results of all modeling for the estimated project completion and design years. The results of these analyses indicate that no violation of the National or Massachusetts AAQS or DEP policy guideline for NO_2 will occur as a consequence of CO or NO_x emissions passing through any ventilation building.

4.10.5 Ventilation Building Design Considerations

In order to conduct the air quality analyses for these structures, reasonable designs for these structures were assumed in order to provide estimates of air quality impacts. The location, size, and design of each ventilation building was preliminarily determined based on engineering and environmental considerations. (See Section 4.9 for a description of these considerations.) It was assumed that the height of each exhaust duct would be approximately 50 percent greater than the height of the appropriate ventilation building. (For example, if a ventilation building is 80 feet tall, the exhaust ducts for that facility would be at a total height of 120 feet.) This is the height generally required to prevent ventilation plumes from being trapped in the cavity region of any building's wake, although the plume will still be influenced by building downwash effects.

As discussed in Section 4.10.4, no violations of any applicable air quality standards are expected due to emissions from any ventilation building. If the dimensions of those buildings significantly change in the course of the project design, additional appropriate studies will be undertaken to determine if applicable ambient air quality standards can continue to be met. A separate report detailing the procedures and results of any additional modeling efforts will be prepared and noticed publicly in the event of such proposed modifications.

4.10.6 Combined Impacts From All Ventilation Buildings

With the exception of ventilation building 1, near Fort Point Channel, and ventilation

Table 4.28

MAXIMUM 1-HOUR NO_x AND NO_2 GROUND LEVEL CONCENTRATIONS IN THE VICINITY OF VENTILATION BUILDINGS 1, 2, 5, 6, AND 7 BASED ON THE RESULTS OF ANALYTICAL (ISCST) MODELING

Ventilation Building	Maximum NO_x ug/m^3	$[NO_2]_c$[1] ug/m^3	$[NO_2]_b$[2] ug/m^3	Total NO_2 ug/m^3
		YEAR 1998		
1	20	9	301	310
2	19	9	301	310
5	32	10	301	311
6	26	9	301	310
7	81	12	301	313
		YEAR 2010		
1	18	9	301	310
2	17	9	301	310
5	28	9	301	310
6	24	9	301	310
7	73	12	301	313

1. $[NO_2]_c$: Calculated contribution of ventilation building emissions based on the ozone limiting method where the background ozone level, .004 ppm (8 micrograms) was measured concurrent with the highest second-highest 1-hour background NO_2 measurements

2. $[NO_2]_b$: NO_2 background concentration is the highest second-highest 1-hour concentration value recorded at the Bremen Street monitoring station during the period 1985 to 1987

Source: Bechtel/Parsons Brinckerhoff

Table 4.29

SECOND-HIGHEST HOURLY TOTAL NO_2 CONCENTRATIONS BY WIND DIRECTION RESULTING FROM EMISSIONS FROM VENTILATION BUILDING 3, BOSTON EDISON SITE BASED ON THE RESULTS OF PHYSICAL MODELING

Wind Direction	Maximum 1-Hour NO_x Concentration From Vent Bldg. 3 Alone[1] (ug/m^3)	Second-Highest 1-Hour Total NO_2 Concentration[2] (ug/m^3)
	YEAR 1998	
N	2.6	182
NNE	9.1	212
NE	32.7	195
ENE	46.7	169
E	23.9	167
ESE	48.7	197
SE	41.2	212
SSE	16.5	175
S	17.3	203
SSW	17.8	184
SW	5.9	192
WSW	1.9	161
W	4.1	192
WNW	2.3	304
NW	7.5	195
NNW	11.0	165
	YEAR 2010	
N	2.3	182
NNE	8.2	212
NE	29.3	193
ENE	41.9	165
E	21.4	163
ESE	43.7	208
SE	36.9	208
SSE	14.8	173
S	15.5	201
SSW	15.9	182
SW	5.3	192

Table 4.29 (Cont.)

SECOND-HIGHEST HOURLY TOTAL NO_2 CONCENTRATIONS BY WIND DIRECTION RESULTING FROM EMISSIONS FROM VENTILATION BUILDING 3, BOSTON EDISON SITE BASED ON THE RESULTS OF PHYSICAL MODELING

Wind Direction	Maximum 1-Hour NO_x Concentration From Vent Bldg. 3 Alone[1] (ug/m^3)	Second-Highest 1-Hour Total NO_2 Concentration[2] (ug/m^3)
	YEAR 2010 (Cont.)	
WSW	1.7	161
W	3.7	192
WNW	2.1	304
NW	6.7	195
NNW	9.9	163

1. Maximum NO_x concentrations based on the results of wind tunnel testing assuming an exhaust air exit velocity of 1,600 feet per minute (fpm) and an exhaust duct height of 240 feet

2. Total NO_2 concentration based on application of the ozone limiting method to the contribution from the ventilation building emissions and background levels monitored during 1985, 1986, and 1987 at the DEP Bremen Street monitoring station

Source: Bechtel/Parsons Brinckerhoff

Table 4.30

SECOND-HIGHEST HOURLY TOTAL NO_2 CONCENTRATIONS BY WIND DIRECTION RESULTING FROM EMISSIONS FROM VENTILATION BUILDING 4, PARCEL 7 SITE BASED ON THE RESULTS OF PHYSICAL MODELING

Wind Direction	Maximum 1-Hour NO_x Concentration From Vent Bldg. 4 Alone[1] (ug/m^3)	Second-Highest 1-Hour Total NO_2 Concentration[2] (ug/m^3)
	YEAR 1998	
N	24.1	201
NE	31.8	220
NE	21.1	186
ENE	47.6	171
E	5.6	150
SE	17.4	171
ESE	28.4	201
SSE	15.3	173
S	11.9	201
SSW	18.9	190
SW	23.6	207
WSW	38.6	192
W	24.6	203
WNW	6.5	306
NW	20.7	207
NNW	11.9	165
	YEAR 2010	
N	21.8	190
NE	28.7	220
NE	19.1	184
ENE	43.0	171
E	5.0	150
SE	15.5	169
ESE	25.7	190
SSE	13.8	173
S	10.8	201
SSW	17.0	188
SW	21.3	205

Table 4.30 (Cont.)

SECOND-HIGHEST HOURLY TOTAL NO_2 CONCENTRATIONS BY WIND DIRECTION RESULTING FROM EMISSIONS FROM VENTILATION BUILDING 4, PARCEL 7 SITE BASED ON THE RESULTS OF PHYSICAL MODELING

Wind Direction	Maximum 1-Hour NO_x Concentration From Vent Bldg. 4 Alone[1] (ug/m^3)	Second-Highest 1-Hour Total NO_2 Concentration[2] (ug/m^3)
	YEAR 2010 (Cont.)	
WSW	34.8	192
W	22.2	203
WNW	5.9	305
NW	18.7	205
NNW	10.8	165

1. Maximum NO_x concentrations based on the results of wind tunnel testing assuming an exhaust air exit velocity of 1,600 feet per minute (fpm) and an exhaust duct height of 240 feet

2. Total NO_2 concentration based on application of the ozone limiting method to the contribution from the ventilation building emissions and background levels monitored during 1985, 1986, and 1987 at the DEP Bremen Street monitoring station

Source: Bechtel/Parsons Brinckerhoff

Table 4.31

MAXIMUM PREDICTED GROUND LEVEL CONCENTRATIONS OF NO_2 AND CO AT ALL VENTILATION BUILDINGS BASED ON THE RESULTS OF ANALYTICAL MODELING

	NO_2 (ug/m^3) 1-Hour[1]	Annual[2]	CO (ppm) 1-Hour	8-Hour
YEAR 1998				
Modeling Procedure	ISCST	ISCLT	ISCST	ISCST
Background Value	301	62.0	5.0	3.0
Ventilation Building				
1	310	62.9	5.1	3.1
2	310	62.8	5.2	3.1
3	N/A[3]	62.8	5.1	3.1
4	N/A[3]	66.1	5.9	3.6
5	311	64.7	5.2	3.2
6	310	63.4	5.2	3.1
7	313	65.4	5.7	3.5
DEP Policy Level	320	N/A[4]	N/A[4]	N/A[4]

Table 4.31 (Cont.)

MAXIMUM PREDICTED GROUND LEVEL CONCENTRATIONS OF NO_2 AND CO AT ALL VENTILATION BUILDINGS BASED ON THE RESULTS OF ANALYTICAL MODELING

	NO_2 (ug/m^3) 1-Hour[1]	Annual[2]	CO (ppm) 1-Hour	8-Hour
	YEAR 2010			
Modeling Procedure	ISCST	ISCLT	ISCST	ISCST
Background Value	301	62.0	5.0	3.0
Ventilation Building				
1	310	62.8	5.1	3.1
2	310	62.8	5.2	3.1
3	N/A[3]	62.7	5.1	3.1
4	N/A[3]	65.7	5.8	3.5
5	310	63.3	5.2	3.2
6	310	63.2	5.2	3.1
7	313	65.0	5.6	3.5
DEP Policy Level	320	N/A[4]	N/A[4]	N/A[4]

1. 1-hour NO_2 values are based on the emission rate for the peak traffic hour, conversion of NO_x to NO_2 using the ozone limiting method, and a 1-hour background concentration of 301 ug/m^3
2. Annual NO_2 values are based on the emission rate for the peak 8-hour average traffic period, an assumed 100 percent conversion of NO_x to NO_2 and an annual average background concentration of 62 ug/m^3
3. Analyzed through wind tunnel studies
4. N/A: Not applicable

Source: Bechtel Parsons Brinckerhoff

Table 4.32

MAXIMUM PREDICTED CONCENTRATIONS OF NO_2 AND CO AT ELEVATED RECEPTORS AT ALL VENTILATION BUILDINGS BASED ON THE RESULTS OF ANALYTICAL MODELING AND WIND TUNNEL STUDIES

	NO_2 (ug/m^3) 1-Hour[1]		NO_2 (ug/m^3) Annual	CO (ppm) 1-Hour	CO (ppm) 8-Hour
YEAR 1998					
Modeling Procedure	Wind Tunnel	ISCST	ISCLT	ISCST	ISCST
Background Value	Variable[1]	Variable[1]	62.0	5.0	3.0
Ventilation Building					
1	N/A[3]	225[4]	62.7[4]	5.1[4]	3.1[4]
2	N/A	225[4]	63.6[4]	5.3[4]	3.2[4]
3	302[2]	N/A	65.1[5]	7.6[5]	4.6[5]
4	302[2]	N/A	72.0[6]	7.6[7]	4.7[7]
5	N/A	N/A	N/A	N/A	N/A
6	N/A	N/A	N/A	N/A	N/A
7	N/A	N/A	N/A	N/A	N/A
AAQS	N/A	N/A	100	35.0	9.0
DEP Policy Level	320	320	N/A	N/A	N/A

Table 4.32 (Cont.)

MAXIMUM PREDICTED CONCENTRATIONS OF NO_2 AND CO AT ELEVATED RECEPTORS AT ALL VENTILATION BUILDINGS BASED ON THE RESULTS OF ANALYTICAL MODELING AND WIND TUNNEL STUDIES

	NO_2 (ug/m^3) 1-Hour[1]		Annual	CO (ppm) 1-Hour	8-Hour
YEAR 2010					
Modeling Procedure	Wind Tunnel	ISCST	ISCLT	ISCST	ISCST
Background Value	Variable[1]	Variable[1]	62.0	5.0	3.0
Ventilation Building					
1	N/A[3]	223[4]	62.6[4]	5.1[4]	3.1[4]
2	N/A	225[4]	63.4[4]	5.3[4]	3.2[4]
3	302[2]	N/A	64.1[5]	7.4[5]	4.6[5]
4	302[2]	N/A	68.9[6]	7.5[7]	4.7[7]
5	N/A	N/A	N/A	N/A	N/A
6	N/A	N/A	N/A	N/A	N/A
7	N/A	N/A	N/A	N/A	N/A
AAQS	N/A	N/A	100	35.0	9.0
DEP Policy Level	320	320	N/A	N/A	N/A

1. NO_2 1-hour background level varies with wind direction
2. Includes second-highest 1-hour NO_2 background concentration (301 ug/m^3) for the WNW wind direction (for direct comparison with DEP policy level)
3. N/A: Not applicable
4. Wang building - roof fresh air intake
5. 125 High Street - building roof
6. Creek Square - building roof
7. JFK Federal Building - roof

Source: Bechtel/Parsons Brinckerhoff

building 2, near the I-93/I-90 Interchange, which are about 350 to 400 feet apart, ventilation buildings are located at least 2,500 feet from each other -- far enough to prevent a combined (or cumulative) air quality impact on nearby receptor locations. However, under certain meteorological conditions, it is possible that the plumes from one or more of the ventilation buildings could merge and cause air quality impacts greater than those for each building alone.

An analysis of the potential cumulative ground-level impacts from the vehicular exhausts passing through ventilation buildings 1, 2, 5, and 6 was made using analytical modeling procedures. These four buildings were assumed to be aligned on a west-east axis (see Figure 4.4). Cumulative impacts with transport winds blowing west to east and east to west were then evaluated. Two wind directions were considered because the relative contribution for an individual source at any given receptor point depends on its distance from a given source. This approach is reasonable because these ventilation buildings generally have a west-east orientation, and conservative because model estimates will be based on centerline (i.e., relatively higher) concentration values since the sources and receptors are assumed to lie along the same line.

Short-term CO (1- and 8-hour averages) and NO_2 (1-hour average) concentrations were estimated. Using winds blowing from west to east and emission rates for the estimated project completion and project design years (1998 and 2010), the respective maximum incremental concentration values were as follows:

- o 273 ug/m^3 (0.24 ppm) and 263 ug/m^3 (0.23 ppm) for 1-hour CO
- o 206 ug/m^3 (0.18 ppm) and 198 ug/m^3 (0.17 ppm) for 8-hour CO
- o 32.9 ug/m^3 and 29.6 ug/m^3 for 1-hour NO_2

Similarly, with winds blowing from east to west and using emission rates for 1998 and 2010, the respective maximum incremental concentration values were as follows:

- o 297 ug/m^3 (0.26 ppm) and 282 ug/m^3 (0.25 ppm) for 1-hour CO
- o 198 ug/m^3 (0.17 ppm) and 190 ug/m^3 (0.17 ppm) for 8-hour CO
- o 31.2 ug/m^3 and 28.0 ug/m^3 for 1-hour NO_2

When added to the background values discussed above (5.0 ppm for 1-hour CO and 3.0 ppm for 8-hour CO), the resultant total concentrations are well below the corresponding AAQS (35 and 9 ppm for 1- and 8-hour CO, respectively). The maximum incremental 1-hour NO_2 values (assuming a 100 percent conversion of NO_x to NO_2) are an order of magnitude below the corresponding DEP guideline value of 320 ug/m^3. Based on these results, the cumulative impacts of CO and NO_x emissions passing through ventilation buildings 1, 2, 5, and 6 are well below the applicable standards and guidelines for both the estimated project completion and design years.

4.10.7 Combined Mobile Source And Ventilation Building Impacts

Mobile source impacts occur primarily adjacent to congested roadways under low wind speeds and stable atmospheric conditions. Peak ground level impacts from vehicular exhausts passing through the ventilation buildings generally occur several hundred feet from the buildings under moderate to high wind speed conditions and unstable atmospheric conditions.

In addition, it is unlikely that the location of maximum air quality impacts from these different source types would be identical. In order to conservatively estimate the potential combined impacts from these sources, peak ground level 1-hour and 8-hour CO concentrations were considered. The highest ground level CO impact from the vehicular exhausts passing through any ventilation building (ventilation building 4) was 1.1 ppm for the peak 1-hour period and 0.6 ppm for the peak 8-hour period (see Table 4.21). When these values are combined with the peak 1-hour and 8-hour CO values predicted for the mobile source analysis (Tables 4.13 and 4.14, respectively), all total predicted values are still less than (in compliance with) the National and Massachusetts AAQS. Therefore, the combined impacts of the mobile sources and ventilation building releases at any receptor location under actual meteorological conditions would be less than (in compliance with) applicable AAQS.

4.11 MITIGATION MEASURES

Based on the results of the analysis of impacts from motor vehicles using the Proposed Action and as a consequence of vehicular emissions passing through the proposed ventilation buildings, it has been determined that the Proposed Action will not result in violations of any National or Massachusetts Ambient Air Quality Standard. Consequently, no specific mitigation measures are required to attain or maintain Ambient Air Quality Standards. However, the final design and operation of the project will include all reasonable measures to reduce the air quality impacts of the Proposed Action, including the use, as appropriate, of transportation management techniques, such as the increased use of ride sharing strategies to reduce the number of vehicles using the roadway network, designation of certain areas or routes as auto-free zones, the application of controls on the use of commercial vehicles, growth management schemes, increased transit operations strategies, and traffic flow management techniques. The practicability, feasibility, and effectiveness of these measures vary significantly, and many require commitments by entities beyond the exclusive jurisdiction of the project sponsors. During the final design of the project, an assessment will be completed, based on fully developed design features and the most recently available traffic estimates, to identify the final set of measures to be applied to reduce the potential air quality impacts of the Artery/Tunnel Project.

4.12 COMPARISON WITH 1985 FEIS/R

There have been a number of design revisions to the Artery/Tunnel Project since the FEIS/R which could potentially generate different air quality impacts than those reported in that document. These include extension of the project limits, and changes to various portions of the project alignment. As a result of these changes, additional receptors have been selected for microscale impact analysis to provide adequate coverage of the entire alignment. In addition, changes to the alignment have resulted in changes in projected traffic volumes and speeds along the alignment and on local streets. These result in changes in vehicular emissions and resulting air quality levels, as compared to the FEIS/R.

The Proposed Action includes seven proposed ventilation buildings. This is two less than the number of ventilation buildings recommended in the FEIS/R. In addition, the locations of ventilation buildings have changed as a result of more detailed site selection and design

studies. Also, it is now estimated that the project will be in compliance with all State and Federal AAQS and DEP NO_2 policy guidelines, unlike the FEIS/R which had projected one area where the predicted 1-hour NO_2 level would not comply with DEP policy guidelines.

In addition to physical changes in alignment and ventilation building locations, additional methods have been employed for assessing impacts. These include: detailed intersection analyses using the CAL3QHC dispersion model; the use of MOBILE 4 emission factor model (released by EPA in May 1989 to replace the MOBLIE 3 version); the addition of receptor locations to include congested intersections and nearby midblock areas; the use of the TRANPLAN traffic assignment model to generate regional and local traffic data; the incorporation of the State I/M program into the emissions calculations; the use of the ozone limiting method in the NO_2 analysis for estimating the impacts of the ventilation buildings to account more accurately for chemical reactions that lead to formation of NO_2 from NO; the use of wind tunnel analyses to provide a more realistic and accurate assessment of impacts of vehicular emissions passing through the ventilation buildings that are located in downtown Boston; and the consideration of elevated receptors in the analysis of the potential impact of emissions from proposed ventilation buildings.

4.13 CONFORMANCE WITH THE STATE IMPLEMENTATION PLAN

The areawide (or mesoscale) analysis shows decreases in emissions of CO, NO_2, and HC with the proposed project. The microscale analysis indicates that there will be no violations of the ambient air quality standards for the years 1998 or 2010 with the project. In addition, CO concentrations in 2010 are estimated to become lower (improve) at 27 locations with the Proposed Action, compared to conditions in the year 2010 without the Proposed Action. Also, no violations of any air quality standards are predicted as a result of pollutants released from any proposed ventilation building. This project is located in an air quality nonattainment area which has transportation control measures in the Massachusetts State Implementation Plan (SIP) which has been conditionally approved by the EPA. The Federal Highway Administration has determined that both the transportation plan and the transportation improvement program conform to the SIP, and that this project is included in the transportation improvement program for the area. This analysis confirms that this project conforms to the SIP.

4.14 RESOLUTION OF ISSUES RAISED BY PUBLIC AGENCIES

A number of air quality-related issues have been identified by public agencies during review of drafts of this document. Major issues identified by public agencies, and recommended to be addressed in this SEIS/R include:

- o A detailed analysis should be completed of the air quality impacts during the construction period of the Proposed Action, including an air quality assessment of proposed maintenance of traffic plans.

- o Measures should be identified to mitigate any adverse impacts of the project, including violations of the AAQS which could result from operation of the Proposed Action.

- o An analysis should be included of the air quality impacts of emissions from proposed ventilation buildings.

- o Justification should be provided for completing an analysis of "interim year," 1998, impacts.

Responses to these issues can be found in the SEIS/R as indicated below.

Included in Chapter 20 (Construction) is an assessment of the short-term construction-related impacts of the Proposed Action, including a description of measures to mitigate expected impacts. As indicated in Chapter 20, once construction staging plans have been finalized, estimates of CO levels will be completed for locations where major construction-related impacts are anticipated to occur. The procedures to be used in assessing these impacts will be the same as the ones used in assessing the operational impacts. Appropriate mitigation strategies and measures to minimize any possible impacts on air quality will be developed and adopted prior to construction.

As indicated in Section 4.11, measures to mitigate operation-related impacts of the project will be identified upon completion of final assessments during the review of this draft document. No violation of any AAQS or policy guideline is predicted with the Proposed Action.

Detailed analytical and physical modeling studies have been completed of the impact of emissions released from the proposed ventilation buildings, the results of which are summarized in Section 4.10. The results of these studies indicate that emissions passing through the proposed ventilation buildings will not result in any violation of the National or State AAQS or guidelines.

An assessment of the impact of the project in the year 1998 was included in the SEIS/R, since 1998 is the estimated year of completion of the project. An analysis of impacts during the estimated year of project completion is required under FHWA guidelines for assessing the impacts of proposed transportation improvements.

Chapter 5 – Noise and Vibration

Chapter 5
NOISE AND VIBRATION

This chapter describes the current noise and vibration levels in the project area and estimates the future impacts due to operation of the Artery/Tunnel Project. Existing noise levels were measured using noise monitors placed near selected sensitive receptors in the Artery/Tunnel Project area. Future noise levels were assessed using FHWA STAMINA 2.0 traffic noise model. Current noise levels and information on traffic volumes, speeds, and vehicle classification were used to calibrate the noise model for the year 2010 baseline (i.e., without the Proposed Action) and the Proposed Action conditions.

Similarly, existing ground vibration levels were determined at sensitive receptor sites and future vibration levels were projected, based on 2010 baseline and Proposed Action traffic conditions.

Where estimated future noise and vibration impacts are likely to occur, mitigation measures are proposed. Stationary noise and vibration sources such as ventilation buildings have been assessed for potential impacts as well. These buildings will be designed and built to be consistent with the Boston noise ordinance.

5.1 AFFECTED ENVIRONMENT: NOISE

Noise-sensitive land uses in the project area include residences, churches, schools, parklands, recreation facilities, and historic and archaeological resources. [See Section 4(f) Evaluation in Part III of the SEIS/R for more details on project effects on parkland and historic and archaeological resources.] Existing noise levels at these locations are generally dominated by noise generated by motor vehicles on expressways, major arterials, and local streets, and by aircraft operations in areas close to Logan International Airport.

5.1.1 Ambient Noise Levels

The basic noise unit employed to describe existing and future noise levels in the project area is the A-weighted decibel (dBA). The dBA provides a measure of the noisiness of sound as subjectively heard by humans. For example, a 3-dBA change in noise level can be barely perceived while a 10-dBA change corresponds to a doubling or halving of loudness (see Noise and Vibration Appendix for details).

Since noise fluctuates from moment to moment, it is common practice to average time-varying noise levels over a specified period of time into a single number called the equivalent noise level (L_{eq}). Many surveys show that the descriptor L_{eq} (1 hour), measured in dBA, correlates well with subjective human response to noise, and properly predicts annoyance due to changes in noise levels.

This document uses the descriptor L_{eq} (1 hour) for the peak traffic hour in dBA for measurements, prediction, and impact assessment. According to FHWA regulations L_{eq}

(1 hour) for the noisiest traffic hour is an appropriate descriptor to assess roadway noise impact. Also, FHWA criteria (summarized in Table 5.1) require that noise abatement be considered if project-generated noise approaches or exceeds the noise abatement criteria (NAC) or if the project will substantially increase noise levels at sensitive locations. A substantial increase in noise levels for highway projects in Massachusetts is defined as a 15-dBA increase over existing noise levels. The Department has determined that a Category B Site "approaches" 67 dBA when the measured or predicted noise level is 66 dBA. For a Category E Site, the "approach" level is 51 dBA.

Noise measurements were made during March 1989 and September 1989 at 40 sites during peak morning (7:00 AM to 10:00 AM) and peak afternoon (4:00 PM to 7:00 PM) traffic hours (see Figure 5.1). [L_{eq} (1 hour) noise levels recorded at these 40 receptor sites in the morning and afternoon peak travel periods are provided in Tables 5.2 through 5.6.] Continuous 24-hour noise monitoring was also conducted at representative land use sites such as sites 14 (Callahan/Sumner Tunnel toll plaza), 22 (the Harbor Towers), 31 (Endicott and Stillman Streets), 34 (Flaherty Park adjacent to the proposed South Boston Bypass Road), and 35 (outside 31 West Fifth Street, South Boston). The 24-hour noise levels characterize daily variations in noise levels at these receptor sites. (These results are presented in Tables 5.7 to 5.11.) The 24-hour measurements show that urban noise generated by road traffic varies very little between peak hours and the midday period. The difference between peak hour noise levels and midday hour noise levels generally lies within 1 to 3 dBA. For this reason, impact assessment is essentially independent of the time of measurement whether peak hour or midday.

Results of the noise measurement program indicate hourly morning L_{eq}'s ranging from 57 dBA to 74 dBA and hourly afternoon L_{eq}'s ranging from 57 dBA to 72 dBA. Such levels are typical of a daytime urban environment; these measurements exclude noise from aircraft sources. Existing noise levels approached or exceeded the FHWA exterior noise criterion (67 dBA for activity Category B, playgrounds and residences) at 32 out of the 40 measurement locations. These locations included playgrounds in the South End and South Boston, a condominium in the Fort Point Channel area, a museum and an artists' colony in South Boston, several locations along Bremen Street in East Boston, and residential, parkland, and historic sites in the downtown Boston and North End areas.

Analysis of the 24-hour noise levels measured at five locations show that the lowest level measured was 53 dBA at Flaherty Park (site 34) between midnight and 1:00 AM. The highest level measured was 80 dBA at the Callahan/Sumner Tunnel toll plaza (site 14) between 8:00 and 9:00 AM. These levels were generated by normal traffic noise superimposed by higher effects produced by accelerating vehicles, airport activities, and downtown traffic on the elevated Central Artery. In the downtown areas, the levels generated by traffic on surface streets and on the Central Artery remain fairly constant throughout the daytime and drop about 5 to 10 dBA lower at nighttime.

5.2 ENVIRONMENTAL CONSEQUENCES: NOISE

5.2.1 Traffic Noise Impacts

Traffic noise impacts of the Artery/Tunnel Project were assessed at each of the 40 receptor sites by comparing the predicted noise levels of the Proposed Action with existing noise

Table 5.1

FEDERAL HIGHWAY ADMINISTRATION
NOISE ABATEMENT CRITERIA

Activity Category	L_{eq} for Noisiest Traffic Hour	Description of Activity Category
A	57 (Exterior)	Lands on which serenity and quiet are of extraordinary significance and serve an important public need; and where the preservation of those qualities is essential if the area is to continue to serve its intended purposes.
B	67 (Exterior)	Picnic areas, recreation areas, playgrounds, active sports areas, parks, residences, motels, hotels, schools, churches, libraries, and hospitals.
C	72 (Exterior)	Developed lands, properties, or activities not included in Categories A or B above.
D	--	Undeveloped lands.
E	52 (Interior)	Residences, motels, public meetings rooms, schools, churches, libraries, hospitals, and auditoriums.

State Criteria For Increase In Noise Level

Increase (dBA)	Subjective Descriptor
0 - 5	No impact
5 - 10	Minor impact
10 - 15	Moderate impact
Greater than 15	Serious impact (substantial)

Source: Highway Traffic Noise in the United States, USDOT, FHWA, April 1986

Table 5.2

COMPARISON OF PREDICTED NOISE LEVELS WITH EXISTING LEVELS: AREA NORTH OF CAUSEWAY STREET [in L_{eq}(1 HOUR) dBA]

Site No.	Site Description	Existing Noise Levels AM	Existing Noise Levels PM	Future Base-line (2010) Noise Levels AM	Future Base-line (2010) Noise Levels PM	Proposed Action (2010) Noise Levels AM	Proposed Action (2010) Noise Levels PM	Proposed Action Over Existing Noise Levels AM	Proposed Action Over Existing Noise Levels PM	Proposed Action Over Future Baseline AM	Proposed Action Over Future Baseline PM	Impac Categ
17	Edward Everett House (Harvard St. Charlestown; approx. 130 ft. from c/l Rutherford Ave.)	68	65	68	71	70	65	2	0	2	-6	No im
18	Paul Revere Landing Park (near City Sq. Charlestown, approx. 300 ft. from c/l Charlestown Bridge)	69	66	70	66	68	64	-1	-2	-2	-2	No im
27	Charles River Building (Lovejoy Place)	69	71	71	72	68	71	-1	0	-3	-1	No im
28	Paul Revere Landing Park (south bank), riverside picnic area near MDC Police patrol boats	70	69	72	71	70	71	0	2	-2	0	No im
29A	Leverett Circle	71	68	74	68	73	71	2	3	-1	3	No im
29B	By the swimming pool northwest of Storrow Dr. (near health club)	61	61	60	62	62	63	1	2	2	1	No im
39	North Point, Cambridge	64	62	64	62	70	68	6	6	6	6	Mino

1. The impact category describes the magnitude of increase above the existing levels generated by the 2010 Proposed Action noise levels
2. A minus (-) symbol means that the Proposed Action levels are expected to be less than existing levels

Source: Bechtel/Parsons Brinckerhoff

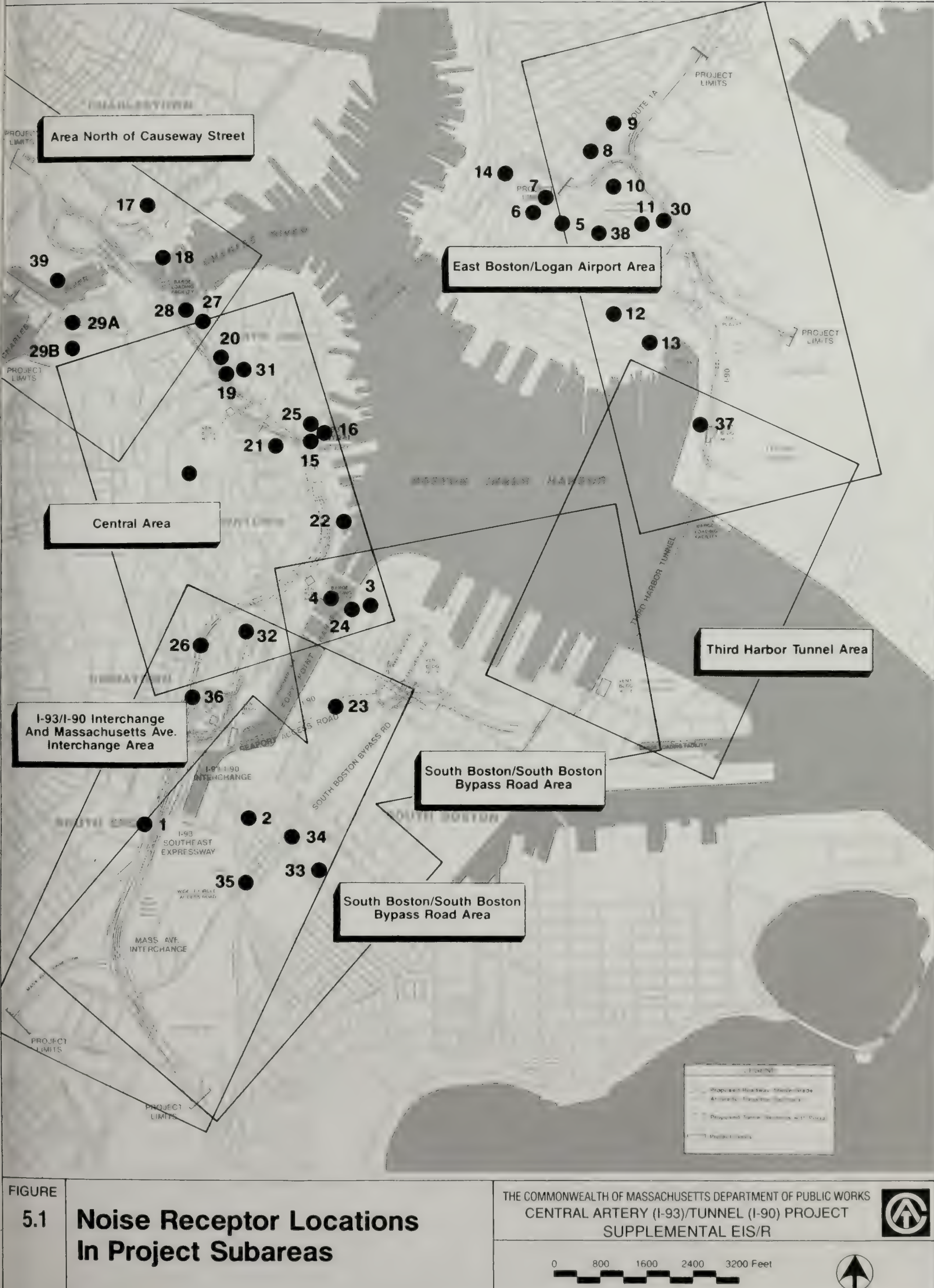

FIGURE 5.1

Noise Receptor Locations In Project Subareas

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

Table 5.3

COMPARISON OF PREDICTED NOISE LEVELS WITH EXISTING LEVELS: CENTRAL AREA [in $L_{eq}(1)$ dBA]

Site No.	Site Description	Existing Noise Levels AM	Existing Noise Levels PM	Future Baseline (2010) Noise Levels AM	Future Baseline (2010) Noise Levels PM	Proposed Action (2010) Noise Levels AM	Proposed Action (2010) Noise Levels PM	Proposed Action Over Existing Noise Levels AM	Proposed Action Over Existing Noise Levels PM	Proposed Action Over Future Baseline AM	Proposed Action Over Future Baseline PM	Impact Category[1]
15	Waterfront (Columbus) Park (110 ft. from c/l Atlantic Ave. approx. 270 ft. from c/l Central Artery)	70	68	72	69	67	65	-3	-3	-5	-4	No impact
16	Waterfront (Columbus) Park at Atlantic Ave.	65	66	66	67	67	68	2	2	1	1	No impact
*19	Apartments, Stillman Place and Stillman St., North End (approx. 75 ft. from c/l Central Artery)	69	68	72	69	69	67	0	-1	-3	-2	No impact
*20	Casa Maria Housing Cooper St. and Lynn St. (North End, approx. 205 ft. from c/l Central Artery)	69	66	71	67	68	66	-1	0	-3	-1	No impact
21	Quincy Market, Commercial St. and North Market St. (approx. 25 ft. from c/l Commercial St. and 135 ft. from c/l Central Artery)	68	67	69	68	69	66	1	-1	0	-2	No impact
*22	Harbor Towers (Approx. 200 ft. from c/l Central Artery)	69	69	71	70	67	67	-2	-2	-4	-3	No impact
25	Waterfront (Columbus) Park (50 ft. from existing Artery)	72	72	74	73	69	70	-3	-2	-5	-3	No impact
*31	Endicott and Stillman Sts.	69	68	71	70	70	72	1	4	-1	2	No impact

1. The impact category describes the magnitude of increase above the existing levels generated by the 2010 Proposed Action noise levels
2. A minus (-) symbol means that the Proposed Action levels are expected to be less than existing levels

* Assumed open windows with 10 dBA attenuation of outdoor levels

Source: Bechtel/Parsons Brinckerhoff

Table 5.4

COMPARISON OF PREDICTED NOISE LEVELS WITH EXISTING LEVELS: I-93/I-90 INTERCHANGE AND MASSACHUSETTS AVENUE INTERCHANGE AREA [in L_{eq}(1 HOUR) dBA]

Site No.	Site Description	Existing Noise Levels AM	PM	Future Base-line (2010) Noise Levels AM	PM	Proposed Action (2010) Noise Levels AM	PM	Proposed Action Over Existing Noise Levels AM	PM	Proposed Action Over Future Baseline AM	PM	Impac Categ
1	Lester J. Rotch Playground (Approx. 120 ft. from c/l Albany St.)	68	64	69	66	70	67	2	3	1	1	No im
+2	St. Peter and Paul Church (Approx. 90 ft. from c/l of Dorchester Avenue)	70	67	71	69	71	68	1	1	0	-1	No in
*26	Sleepworks - Corner of Kneeland and Hudson Streets	69	69	71	70	71	71	2	2	0	1	No in
*32	Fur Merchants Cold Storage (717 Atlantic Avenue)	74	71	75	72	73	70	-1	-1	-2	-2	No in
*36	Hudson St. between Harvard and Tai Tung Streets	65	64	65	65	69	69	4	5	4	4	No in

1. The impact category describes the magnitude of increase above the existing levels generated by the 201 Proposed Action noise levels
2. A minus (-) symbol means that the Proposed Action levels are expected to be less than existing levels

* Open window condition assumed. Outdoor-to-indoor noise reduction of 10 dBA is assumed.

\+ Closed window condition assumed. Outdoor-to-indoor noise reduction of 25 dBA is estimated.

Source: Bechtel/Parsons Brinckerhoff

Table 5.5

COMPARISON OF PREDICTED NOISE LEVELS WITH EXISTING LEVELS: SOUTH BOSTON/SOUTH BOSTON BYPASS ROAD AREA [in L_{eq}(1 HOUR) dBA]

Site No.	Site Description	Existing Noise Levels		Future Baseline (2010) Noise Levels		Proposed Action (2010) Noise Levels		Proposed Action Over Existing Noise Levels		Proposed Action Over Future Baseline		Impact Category[1]
		AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	
3	Dockside Place condominiums (15 Sleeper Street)	69	69	71	71	72	69	3	0	1	-2	No impact
4	Boston Tea Party Museum (approx. 100 ft. from c/l Congress St.)	71	71	73	74	73	72	2	1	0	-2	No impact
2	Artists Colony, 247 A St.	72	72	74	74	72	72	0	0	-2	-2	No impact
[illegible]	Childrens Museum - South Boston, Congress Street	68	65	68	67	68	66	0	1	0	-1	No impact
3	South Boston (West Broadway and C Street intersection)	72	70	73	73	73	72	1	2	0	-1	No impact
4	South Boston Flaherty Park, adjacent to Conrail ROW, near West Second Street	59	57[3]	64	65	71	71	12	14	7	6	Moderate impact
5	31 West Fifth St.	62	61 63	66	72	73	10	12	9	7		Moderate impact

1. The impact category describes the magnitude of increase above the existing levels generated by the 2010 Proposed Action noise levels
2. A minus (-) symbol means that the Proposed Action levels are expected to be less than existing levels
3. Measurement taken when children were playing in the park was 72 dBA
4. Assumed closed window condition with outdoor-to-indoor noise reduction of 25 dBA
5. Assumed open window conditions with 10 dBA noise reduction

Source: Bechtel/Parsons Brinckerhoff

Table 5.6

COMPARISON OF PREDICTED NOISE LEVELS WITH EXISTING LEVELS: EAST BOSTON/LOGAN AIRPORT AREA [in L_{eq}(1 HOUR) dBA]

Site No.	Site Description	Existing Noise Levels		Future Baseline (2010) Noise Levels		Proposed Action (2010) Noise Levels		Proposed Action Over Existing Noise Levels		Proposed Action Over Future Baseline		Impa Cate
		AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	
5	Rear of 74-75 Frankfort St. (approx. 100 ft. from Orleans St.)	58	58	60	59	59	59	1	1	-1	0	No i
*6	Front of 120-122 Bremen St. (between Porter and Gove Sts.)	66	63	68	67	68	66	2	3	0	-1	No i
*7	Corner of Bremen St. and Porter St. near residences	71	71	73	73	75	72	4	1	2	-1	No i
*8	Front of Open Lot on Bremen St. (between Marion and Brooks Sts.)	68	68	70	70	68	67	0	-1	-2	-3	No i
*9	Front of Open Lot on Bremen St. (between Brooks and Putnam St.)	67	68	69	70	69	69	2	1	0	-1	No i
10	East Boston Recreation Area (at (at home plate of west baseball field)	62	63	63	65	63	64	1	1	0	-1	No i
11	East Boston Memorial Stadium Park (at home plate of east baseball field)	68	69	71	72	68	70	0	1	-3	-2	No i
*12	Front of 347 Maverick Street (between Ardee and Lamson Sts.)	66	63	66	64	66	64	0	1	0	0	No i
13	Porzio Park (Jeffries Pt. East Boston)	62	63	65	65	65	64	3	1	0	-1	No i
14	Callahan/Sumner Tunnel Toll Plaza (MTA parking lot)	69	71	70	72	69	73	0	2	-1	1	No i

Table 5.6 (Cont.)

COMPARISON OF PREDICTED NOISE LEVELS WITH EXISTING LEVELS: EAST BOSTON/LOGAN AIRPORT AREA [in L_{eq}(1 HOUR) dBA]

Site Description	Existing Noise Levels		Future Base-line (2010) Noise Levels		Proposed Action (2010) Noise Levels		Proposed Action Over Existing Noise Levels		Proposed Action Over Future Baseline		Impact Category[1]
	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	
East Boston Memorial Stadium Park (on tennis courts about 100 ft. north of Egress Road)	65	68	67	71	71	71	6	3	4	0	No impact to minor impact
Jeffries Cove (Macomber Property)	57	60	58	61	61	60	4	0	3	-1	No impact
194 Cottage St. (Corner of Cottage and Porter Sts.)	67	63	71	67	67	68	0	5	-4	1	No impact

1 The impact category describes the magnitude of increase above the existing levels generated by the 2010 Proposed Action noise levels

2 A minus (-) symbol means that the Proposed Action levels are expected to be less than existing levels

* Assumed open window conditions with 10 dBA noise reduction

Source: Bechtel/Parsons Brinckerhoff

Table 5.7

VARIATION OF HOURLY L_{eq} OVER A 24-HOUR PERIOD[1]
AT THE CALLAHAN/SUMNER TUNNEL TOLL PLAZA[2]
(Site 14)

Hour of Day	Hourly L_{eq} (dBA)
Midnight - 1 AM	69
1 AM - 2 AM	67
2 AM - 3 AM	73
3 AM - 4 AM	74
4 AM - 5 AM	77
5 AM - 6 AM	75
6 AM - 7 AM	74
7 AM - 8 AM	77
8 AM - 9 AM	80
9 AM - 10 AM	77
10 AM - 11 AM	77
11 AM - 12 Noon	77
12 Noon - 1 PM	77
1 PM - 2 PM	74
2 PM - 3 PM	75
3 PM - 4 PM	73
4 PM - 5 PM	72
5 PM - 6 PM	68
6 PM - 7 PM	72
7 PM - 8 PM	72
8 PM - 9 PM	71
9 PM - 10 PM	69
10 PM - 11 PM	71
11 PM - Midnight	71

1. March 15-16, 1989
2. Measurement Site Number 14

Source: Bechtel/Parsons Brinckerhoff

Table 5.8

VARIATION OF HOURLY L_{eq} OVER A 24-HOUR PERIOD[1]
AT HARBOR TOWER BUILDING
(Site 22)

Hour of Day	Hourly L_{eq} (dBA)
Midnight - 1 AM	71
1 AM - 2 AM	71
2 AM - 3 AM	71
3 AM - 4 AM	66
4 AM - 5 AM	68
5 AM - 6 AM	68
6 AM - 7 AM	72
7 AM - 8 AM	72
8 AM - 9 AM	71
9 AM - 10 AM	70
10 AM - 11 AM	73
11 AM - 12 Noon	71
12 Noon - 1 PM	72
1 PM - 2 PM	74
2 PM - 3 PM	73
3 PM - 4 PM	72
4 PM - 5 PM	70
5 PM - 6 PM	69
6 PM - 7 PM	70
7 PM - 8 PM	67
8 PM - 9 PM	69
9 PM - 10 PM	65
10 PM - 11 PM	68
11 PM - Midnight	72

1. March 28-29, 1989

Source: Bechtel/Parsons Brinckerhoff

Table 5.9

VARIATION OF HOURLY L_{eq} OVER A 24-HOUR PERIOD[1] AT STILLMAN AND ENDICOTT STREET RESIDENCES (Site 31)

Hour of Day	Hourly L_{eq} (dBA)
Midnight - 1 AM	65
1 AM - 2 AM	63
2 AM - 3 AM	62
3 AM - 4 AM	62
4 AM - 5 AM	64
5 AM - 6 AM	65
6 AM - 7 AM	69
7 AM - 8 AM	74
8 AM - 9 AM	73
9 AM - 10 AM	72
10 AM - 11 AM	73
11 AM - 12 Noon	73
12 Noon - 1 PM	73
1 PM - 2 PM	72
2 PM - 3 PM	75
3 PM - 4 PM	71
4 PM - 5 PM	72
5 PM - 6 PM	68
6 PM - 7 PM	68
7 PM - 8 PM	68
8 PM - 9 PM	69
9 PM - 10 PM	67
10 PM - 11 PM	67
11 PM - 12 Midnight	66

1. March 14-15, 1989

Source: Bechtel/Parsons Brinckerhoff

Table 5.10

VARIATION OF HOURLY L_{eq} OVER A 24-HOUR PERIOD[1]

AT FLAHERTY PARK
(Site 34)

Hour of Day	Hourly L_{eq} (dBA)
Midnight - 1 AM	53
1 AM - 2 AM	54
2 AM - 3 AM	54
3 AM - 4 AM	54
4 AM - 5 AM	56
5 AM - 6 AM	56
6 AM - 7 AM	62
7 AM - 8 AM	62
8 AM - 9 AM	61
9 AM - 10 AM	61
10 AM - 11 AM	60
11 AM - 12 Noon	60
12 Noon - 1 PM	60
1 PM - 2 PM	62
2 PM - 3 PM	61
3 PM - 4 PM	61
4 PM - 5 PM	64
5 PM - 6 PM	62
6 PM - 7 PM	63
7 PM - 8 PM	59
8 PM - 9 PM	58
9 PM - 10 PM	56
10 PM - 11 PM	56
11 PM - 12 Midnight	55

1. September 12-13, 1989

Source: Bechtel/Parsons Brinckerhoff

Table 5.11

VARIATION OF HOURLY L_{eq} OVER A 24-HOUR PERIOD[1]

AT 25-31 WEST FIFTH STREET, SOUTH BOSTON

(Site 35)

Hour of Day	Hourly L_{eq} (dBA)
Midnight - 1 AM	56
1 AM - 2 AM	56
2 AM - 3 AM	54
3 AM - 4 AM	55
4 AM - 5 AM	55
5 AM - 6 AM	55
6 AM - 7 AM	62
7 AM - 8 AM	61
8 AM - 9 AM	62
9 AM - 10 AM	59
10 AM - 11 AM	60
11 AM - 12 Noon	61
12 Noon - 1 PM	61
1 PM - 2 PM	59
2 PM - 3 PM	63
3 PM - 4 PM	60
4 PM - 5 PM	61
5 PM - 6 PM	59
6 PM - 7 PM	59
7 PM - 8 PM	58
8 PM - 9 PM	61
9 PM - 10 PM	60
10 PM - 11 PM	57
11 PM - 12 Midnight	57

1. September 13-14, 1989

Source: Bechtel/Parsons Brinckerhoff

levels, with year 2010 baseline noise levels (without the Proposed Action), and with the FHWA noise criteria for the applicable land use category.

5.2.1(a) Comparison With Existing Noise Levels

For impact assessment based on comparing future project levels with existing levels, the following impact classifications are used.

Impact Classification	Increase Over Existing Level
No Impact	less than 5 dBA
Minor Impact	5 to 10 dBA
Moderate Impact	10 to 15 dBA
Substantial Impact	more than 15 dBA

In terms of design year (2010) noise levels, it is estimated that noise levels with the Proposed Action will produce no change at one receptor (Location 23) in South Boston. Future noise levels will be 1 to 3 dBA quieter than existing conditions at four sensitive receptors in the vicinity of the existing Central Artery (Locations 16, 22, 25, and 32), at two receptors in the Area North of Causeway Street (Locations 18 and 27), at two apartment houses in the North End (Locations 19 and 20), and at Bremen Street in East Boston (Location 8). Along the Central Artery there will be a 1-dBA increase at one receptor (Location 21) and a 2-dBA increase at one receptor (Location 16).

Near viaducts and at-grade locations, future noise levels caused by the Proposed Action are estimated to be 1 to 3 dBA higher than existing levels (Locations 1, 17, 27, and 28). In the Fort Point Channel area, noise levels with the Proposed Action are estimated to be 1 to 2 dBA higher at the Boston Tea Party Museum (Location 4) and 1 dBA higher at the Children's Museum in South Boston (Location 24) than existing levels. A 1- to 3-dBA increase will occur at Locations 29A and 29B in the Leverett Circle area.

Noise level increases of up to 6 dBA over the existing levels are predicted at East Boston Memorial Stadium Park (Location 30). Increases of 12 to 14 dBA are predicted at Flaherty Park (Location 34) and of 10 to 12 dBA at 31 West Fifth Street (Location 35). (Reasonable mitigation measures are discussed in Section 5.3.)

In summary, the predicted noise levels will be less than the existing levels at nine locations, resulting in an improvement over the existing noise environment. Reduction in noise levels at locations in the Central Area and at some locations north of Causeway Street will be due partly to the elimination of the existing Central Artery as a source of noise. The predicted noise levels will be less than 5 dBA above the existing levels at 23 out of the 40 locations. Subjectively, these changes will be barely noticeable to the general public. At two locations near major interchanges [North Point in Cambridge, and Location 36 (Hudson Street between Harvard and Tai Tung Streets)], and at one East Boston location (Location 38, 194 College Street), increases of 5 to 6 dBA over the existing levels are predicted and will be noticed as a minor impact. At the present time, no sensitive land uses are involved near the CANA loop interchange. At one park location (site 30), increases of 6 dBA over existing levels will be noticeable. At another park location (site 34), and at one residential apartment location (site 35), increases of 12 to 14 dBA will be noticed as a moderate impact.

5.2.1(b) Comparison With Future Baseline Levels

Predicted future 2010 baseline noise levels are included here for comparison with existing noise levels and with estimates of projected levels under the Proposed Action. Future baseline noise levels (without the Proposed Action) were predicted at each of the 40 locations where existing noise levels have been determined in the project area, and they are also summarized in Tables 5.2 through 5.6. A total of 39 sites will experience an increase in future baseline noise levels over existing noise levels ranging from 1 to 8 decibels. Increases of 7 decibels would occur at one park site, Location 34 (Flaherty Park). Increases of 6 dBA would occur at Location 17 (north of Causeway Street). Increases of 5 dBA would occur at Location 35 in South Boston. Increases of 3 to 4 dBA would occur at Locations 6 and 12 in East Boston. At the other locations increases would be 4 dBA or less over the existing levels.

The future predicted noise levels of the Proposed Action will be less than the future baseline noise levels at 22 out of the 40 locations. Future noise levels are estimated to be higher than the future baseline noise levels at the following locations: Locations 1, 3, 7, 14, 16, 17, 26, 29A, 29B, 31, and 38 (1 dBA), Location 37 (3 dBA), Locations 30 and 36 (4 dBA), Location 39 (6 dBA), Location 34 (7 dBA), and Location 35 (9 dBA). At one location (12) there would be no change.

Subjectively, the change in predicted noise levels with the Proposed Action compared to the 2010 baseline conditions will be noticeable at three locations (Locations 34, 35, and 39; see Tables 5.2 and 5.5) and is to be classified as a minor impact. At the other 22 locations, there will be an improvement, with a noticeable decrease in level at Locations 16 and 25 of 5 dBA, and Location 25 of 4 dBA.

5.2.1(c) Comparison With FHWA Criteria

Noise levels with the Proposed Action will exceed the existing noise level at Location 34 (Flaherty Park) by 14 dBA. Furthermore, predicted noise levels with the Proposed Action will approach or exceed the FHWA outdoor noise abatement criterion of L_{eq} (1 hour) = 67 dBA (Category B sites) or indoor criterion of L_{eq}(1 hour) = 52 dBA (Category E sites) at 33 out of the 40 sites. (There are 22 sites in the FHWA land use Category B and 18 sites in Category E.) The existing noise levels currently approach or exceed FHWA criteria at 34 out of the 40 sites. Future baseline noise levels without the Proposed Action would exceed the FHWA criteria at 36 out of the 40 sites.

For Category B sites, outdoor noise levels with the Proposed Action are estimated to approach or exceed the FHWA criteria at six locations in the Area North of Causeway Street (17, 18, 27, 28, 29A, and 39; see Table 5.12), at four locations in the Central Area (15, 16, 21, and 25; see Table 5.13), at one location in the I-93/I-90 Interchange and Massachusetts Avenue Interchange Area (1; see Table 5.14), at four locations in the South Boston and South Boston Bypass Road Area (3, 4, 34, and 35; see Table 5.15), and three locations in the East Boston/Logan Airport Area (11, 14, and 30; see Table 5.16).

To assess interior impacts of the Proposed Action at the 18 Category E sites, open windows were assumed at 15 sites to provide an outdoor-to-indoor noise reduction of 10 dBA. These sites are residential and affected by traffic noise but do not have outdoor activities. Location 5 was assessed as an indoor site with open windows but met FHWA criteria. Impact assessment at the remaining two sites, the Ss. Peter and Paul Church (Location 2) and Childrens Museum (Location 24), assumed closed windows that provide an outdoor-to-indoor

Table 5.12

OMPARISON OF PREDICTED NOISE LEVELS [in L_{eq}(1 HOUR) dBA] WITH FHWA CRITERIA: AREA NORTH OF CAUSEWAY STREET

Site Description	Existing Noise Levels		Future Base-line (2010) Noise Levels		Proposed Action (2010) Noise Levels		FHWA Criteria NAC[1]	Future Baseline Over NAC		Proposed Action Over NAC		Noise Abatement To Be Considered[2]
	AM	PM	AM	PM	AM	PM		AM	PM	AM	PM	
Edward Everett House (Harvard St. Charlestown; approx. 130 ft. from c/l Rutherford Ave.)	68	65	68	71	68	64	67	1	4	1	-3	Yes
Paul Revere Landing Park (near City Sq. Charlestown, approx. 300 ft. from c/l Charlestown Bridge)	69	66	70	66	69	64	67	3	-1	2	-3	Yes
Charles River Building (Lovejoy Place)	69	71	71	72	68	71	67	4	5	1	4	Yes
Paul Revere Landing Park (south bank), riverside picnic area near MDC Police patrol boats	70	69	72	71	70	71	67	5	4	3	4	Yes
Leverett Circle	71	68	74	68	73	71	67	7	1	6	4	Yes
By the swimming pool northwest of Storrow Dr. (near health club)	61	61	60	62	62	63	67	-7	-5	-5	-4	No
North Point, Cambridge	62	64	64	62	70	68	67	-3	-5	3	1	Yes

NAC-FHWA Noise Abatement Criteria

Noise abatement to be considered is based on satisfying FHWA NAC

rce: Bechtel/Parsons Brinckerhoff

Table 5.13

COMPARISON OF PREDICTED NOISE LEVELS [in L_{eq}(1 HOUR) dBA] WITH FHWA CRITERIA: CENTRAL AREA

Site No.	Site Description	Existing Noise Levels AM	Existing Noise Levels PM	Future Baseline (2010) Noise Levels AM	Future Baseline (2010) Noise Levels PM	Proposed Action (2010) Noise Levels AM	Proposed Action (2010) Noise Levels PM	FHWA Criteria NAC[1]	Future Baseline Over NAC AM	Future Baseline Over NAC PM	Proposed Action Over NAC AM	Proposed Action Over NAC PM	Noi Abat To I Cons
15	Waterfront (Columbus) Park (110 ft. from c/lAtlantic Ave. approx. 270 ft. from c/l Central Artery)	70	68	72	69	67	65	67	5	2	0	-2	Y
16	Waterfront (Columbus) Park at Atlantic Ave.	65	66	66	67	67	68	67	-1	0	0	1	Y
*19	Apartments, Stillman Place and Stillman St., North End (approx. 75 ft. from c/l Central Artery)	69	68	72	69	69	67	52	10	7	7	5	Y
*20	Casa Maria Housing Cooper St. and Lynn St. (North End, approx. 205 ft. from c/l Central Artery)	69	66	71	67	68	66	52	9	5	6	4	Y
21	Quincy Market, Commercial St. and North Market St. (approx. 25 ft. from c/l Commercial St. and 135 ft. from c/l Central Artery)	68	67	69	68	69	66	67	2	1	2	-1	Y
*22	Harbor Towers (Approx. 200 ft. from c/l Central Artery)	69	69	71	70	67	67	52	9	8	5	5	Y
25	Waterfront (Columbus) Park (50 ft. from existing Artery)	72	72	74	73	69	70	67	7	6	2	3	Y
*31	Endicott and Stillman Sts.	69	68	71	70	70	72	52	9	8	8	10	Y

1. NAC-FHWA Noise Abatement Criteria
2. Noise abatement to be considered is based on satisfying FHWA NAC

* Assumed open windows with 10 dBA attenuation of outdoor levels

Levels reported are outdoor noise levels, not reduced by open windows

Source: Bechtel/Parsons Brinckerhoff

Table 5.14

COMPARISON OF PREDICTED NOISE LEVELS [in L_{eq}(1 HOUR) dBA] WITH FHWA CRITERIA: I-93/I-90 INTERCHANGE AND MASSACHUSETTS AVENUE INTERCHANGE AREA

ite Description	Existing Noise Levels		Future Base-line (2010) Noise Levels		Proposed Action (2010) Noise Levels		FHWA Criteria NAC[1]	Future Baseline Over NAC		Proposed Action Over NAC		Noise Abatement To Be Considered[2]
	AM	PM	AM	PM	AM	PM		AM	PM	AM	PM	
1 ester J. Rotch Playground Approx. 120 ft. from c/l Albany St.)	68	64	69	66	70	67	67	2	-1	3	0	Yes
t. Peter and Paul Church Approx. 90 ft. from c/l of Dorchester Avenue)	70	67	71	69	71	68	52	-6	-8	-6	-9	No
leepworks - Corner of Kneeland nd Hudson Streets	69	69	71	70	71	71	52	9	8	9	9	Yes
ur Merchants Cold Storage 717 Atlantic Avenue)	74	71	75	72	73	70	52	13	10	11	8	Yes
Iudson St. between Harvard nd Tai Tung Streets	65	64	65	65	69	69	52	3	3	7	7	Yes

NAC-FHWA Noise Abatement Criteria

Noise abatement to be considered is based on satisfying FHWA NAC

Closed window condition assumed; outdoor-to-indoor noise reduction of 25 dBA is estimated; levels eported are outdoor noise levels, not reduced by closed windows

Open window condition assumed; outdoor-to-indoor noise reduction of 10 dBA is assumed; levels reported re outdoor levels, not reduced by windows

ue: Bechtel/Parsons Brinckerhoff

Table 5.15

COMPARISON OF PREDICTED NOISE LEVELS [in L_{eq}(1 HOUR) dBA] WITH FHWA CRITERIA: SOUTH BOSTON AND SOUTH BOSTON BYPASS ROAD AREA

Site No.	Site Description	Existing Noise Levels		Future Base-line (2010) Noise Levels		Proposed Action (2010) Noise Levels		FHWA Criteria NAC[1]	Future Baseline Over NAC		Proposed Action Over NAC		No Aba To Con
		AM	PM	AM	PM	AM	PM		AM	PM	AM	PM	
3	Dockside Place condominiums (15 Sleeper Street)	69	69	71	71	72	69	67	4	4	5	2	Y
4	Boston Tea Party Museum (approx. 100 ft. from c/l Congress St.)	71	71	73	74	73	72	67	6	7	6	5	Y
*23	Artists Colony, 247 A St.	72	72	74	74	72	72	52	12	12	10	10	Y
+24	Childrens Museum - South Boston, Congress Street	68	65	68	67	68	66	52	-11	-10	-9	-11	N
*33	South Boston (West Broadway and C Street intersection)	72	70	73	73	73	72	52	11	11	11	10	Y
**34	South Boston Flaherty Park, adjacent to Conrail ROW, near West Second St.	59	57	64	65	71	71	67	-3	-2	4	4	Y
35	31 West Fifth St.	62	59	63	66	72	73	67	-4	-1	5	6	Y

1. NAC-FHWA Noise Abatement Criteria
2. Noise abatement to be considered is based on satisfying FHWA NAC

\+ Assumed closed window condition with outdoor-to-indoor noise reduction of 25 dBA

* Assumed open window conditions with 10 dBA noise reduction

** On September 6, 1988, noise measurements were taken while children were playing in the afternoon w resulted in a 72 L_{eq}(1) measurement

Levels reported are outdoor noise levels, not reduced by open or closed windows

Source: Bechtel/Parsons Brinckerhoff

Table 5.16

OMPARISON OF PREDICTED NOISE LEVELS [in L_{eq}(1 HOUR) dBA] WITH FHWA CRITERIA: EAST BOSTON/LOGAN AIRPORT AREA

ite Description	Existing Noise Levels		Future Base-line (2010) Noise Levels		Proposed Action (2010) Noise Levels		FHWA Criteria NAC[1]	Future Baseline Over NAC		Proposed Action Over NAC		Noise Abatement To Be Considered[2]
	AM	PM	AM	PM	AM	PM		AM	PM	AM	PM	
ear of 74-75 Frankfort St. ıpprox. 100 ft. from Orleans St.)	58	58	60	59	59	59	52	-2	-3	-3	-3	No
ront of 120-122 Bremen St. between Porter and Gove Sts.)	66	63	68	67	68	66	52	6	5	6	4	Yes
orner of Bremen St. and Porter t. near residences	71	71	73	73	75	72	52	11	11	13	10	Yes
ront of Open Lot on Bremen St. etween Marion and Brooks Sts.)	68	68	70	70	68	67	52	8	8	6	5	Yes
ront of Open Lot on Bremen St. etween Brooks and Putnam St.)	67	68	69	70	69	69	52	7	8	7	7	Yes
ast Boston Recreation Area (at t home plate of west baseball field)	62	63	63	65	63	64	67	-4	-2	-4	-3	No
ast Boston Memorial Stadium Park t home plate of east baseball field)	68	69	71	72	70	72	67	4	5	3	5	Yes
ront of 347 Maverick Street etween Ardee and Lamson Sts.)	66	63	66	64	66	64	52	4	2	4	2	Yes
orzio Park (Jeffries Pt. East oston)	62	63	65	65	65	64	67	-2	-2	-2	-1	No
allahan/Sumner Tunnel Toll laza (MTA parking lot)	69	71	70	72	69	73	67	3	5	2	6	Yes

Table 5.16 (Cont.)

COMPARISON OF PREDICTED NOISE LEVELS [in L_{eq}(1 HOUR) dBA] WITH FHWA CRITERIA: EAST BOSTON/LOGAN AIRPORT AREA

Site No.	Site Description	Existing Noise Levels		Future Baseline (2010) Noise Levels		Proposed Action (2010) Noise Levels		FHWA Criteria NAC[1]	Future Baseline Over NAC		Proposed Action Over NAC		Noi Abat To Cons
		AM	PM	AM	PM	AM	PM		AM	PM	AM	PM	
30	East Boston Memorial Stadium Park (on tennis courts about 100 ft. north of Egress Road)	65	68	67	71	72	74	67	0	4	5	7	Y
37	Jeffries Cove (McComber Property)	57	60	58	61	61	60	67	-9	-6	-6	-7	N
*38	194 Cottage St. (Corner of Cottage and Porter Sts.)	67	63	71	67	67	68	52	9	5	5	6	Y

1. NAC-FHWA Noise Abatement Criteria (NAC)
2. Noise abatement to be considered is based on satisfying FHWA NAC

* Assumed open windows with 10 dBA reduction

Levels reported are outdoor noise levels, not reduced by open windows

Source: Bechtel/Parsons Brinckerhoff

noise reduction of 25 dBA. Noise reduction of 10 dBA for open windows is based on exterior walls having a 4-percent area of open windows, and noise reduction of 25 dBA for closed windows is for light frame buildings with ordinary sash for storm windows. Based on FHWA criteria, 33 locations will experience noise impacts with the Proposed Action and will require consideration of noise abatement.

5.2.2 Ventilation Noise Levels

There are seven ventilation buildings included in the Proposed Action. Two will be located in each of the following subareas: the Central Area, the I-93/I-90 Interchange area, and the South Boston area. One will be located in the East Boston/Logan Airport Area.

The project design criteria developed for exterior noise levels are consistent with the City of Boston Code, Ordinances, Title 7, Section 50. Regulation 2 includes property line restrictions for residential, business, and industrial zoning districts. The limits are 50 dBA during the nighttime and 60 dBA during the daytime at the lot lines of nearest residences, and 70 dBA at all times for industrial areas. In addition, the project design criteria will comply with the Massachusetts Department of Environmental Protection (DEP) guidelines that a facility should not increase the broad band noise level by more than 10 dBA above the ambient (existing) level. Noise with a pure tone component shall not exceed ambient level by 5 dBA or more. (A pure tone condition occurs when any octave band center frequency sound pressure level exceeds the two adjacent center frequency sound pressure levels by 3 decibels or more.) The DEP guidelines apply to locations at the property line as well as at the nearest inhabited residences.

Preliminary Assessment of noise impacts from ventilation buildings (specifically from fans and ducting) without sound attenuation measures include the following results (see Table 5.17). No violations of the DEP noise criterion (i.e., an increase of 10 dBA or more over ambient levels) will occur at residential sites, either during daytime or nighttime. Daytime noise levels at two commercial sites (USPS parking near ventilation building 1 and Nagel Seafood near ventilation building 6) will exceed the DEP criterion by 8 to 10 dBA, respectively. Nighttime noise levels at two commercial sites (USPS parking near ventilation building 1 and 108-114 Blackstone Street near ventilation building 4) will exceed the DEP criterion by 11 dBA and meet it, respectively. In addition, nighttime noise levels will exceed the DEP criterion at three industrial sites (vacant lands near ventilation building 5, 2 dBA; Nagel Seafood, 15 dBA; and airport parking near ventilation building 7, 2 dBA). Although the criterion will be exceeded at these five commercial and industrial sites, they are not expected to be inhabited at nighttime. In addition, attenuation measures will be provided where required.

The Central Area ventilation buildings 3 and 4 will both be located below grade. As a consequence, the equipment will be insulated and will not increase community noise levels. The intake and exhaust ducts will be adequately silenced by lining the ducts with a sound absorbing material to attenuate the fan noise to be consistent with the Boston City Noise Ordinance for the daytime and nighttime allowable levels. The I-93/I-90 Interchange area ventilation buildings 1 and 2 will be above grade and partially above grade, respectively. The contribution from these buildings will be well below the traffic noise levels in the area. The project noise criteria of 60 dBA for daytime operation and 50 dBA for nighttime operation will not be exceeded because adequate attenuation of the ventilation building

Table 5.17

VENTILATION NOISE ASSESSMENT SUMMARY

Vent Bldg.	Adjacent And Other Nearby Land Uses (Receptors)			Fan Noise Levels				Ambient Noise Levels		Increase Over Ambient Noi		
				Day		Night		Day	Night	Day		Night
	Description	Type	Distance	Exhaust	Supply	Exhaust	Supply	L_{90}	L_{90}	Exhaust	Supply	Exhaust
1	USPS Parking	Industrial	60'	70	74	63	67	56	46	7	18	17
	Wang Building	Commercial	700'	47	51	40	44	63	53	-19	-12	-13
	Chinatown	Residential	1200'	43	46	36	39	60	50	-21	-14	-14
2	Wang Bulding	Commercial	250'	52	52	44	47	83	53	-14	-1	-9
	Chinatown	Residential	500'	46	45	38	41	60	50	-18	-15	-12
3	Russia Wharf	Commerical	60'	69	70	62	65	69	59	-6	1	3
	470 Atlantic Ave	Commercial	50'	69	70	62	65	69	59	-6	1	3
4	108-114 Blackstone	Commercial	100'	65	65	57	60	60	50	-1	5	7
	Bostonian Hotel	Hotel	300'	55	58	48	51	65	55	-12	-9	-7
	North End	Residential	400'	53	53	45	48	66	56	-15	-13	-11
5	Vacant Lands	Industrial	60'	69	70	62	64	62	52	-6	8	10
	259 A Street	Residential	1350'	41	41	33	36	60	50	-31	-19	-17
6	Nagel Seafood	Industrial	50'	68	68	60	63	48	38	4	20	22
7	Airport Parking	Industrial	50'	69	70	62	65	61	51	-3	9	11
	Residences	Residential	1500'	39	40	32	36	60	50	-28	-20	-18

1. Daytime exhaust conditions are based on emergency ventilation airflow
2. Daytime supply conditions are based on maximum normal ventilation airflow
3. Nighttime supply and exhaust conditions are based on 37 percent of maximum normal ventilation airflow
4. Results presented do not incldue sound attenuation measures
5. L_{90} means noise level will be within level indicated 90 percent of the time
6. The four columns of table at the right are not in the above report; they were added for this analysis

Source: Tunnel Ventilation Fan and Motor Drive Selection, Concept Report, Bechtel/Parsons Brinckerhoff, November 1989

exterior walls and silencing for the supply and exhaust fans will be provided. The South Boston area ventilation buildings 5 and 6 will be above grade and partially above grade, respectively. They are located in industrial areas, and their design will comply with a maximum noise level of 70 dBA for daytime and nighttime operations. The East Boston/Logan Airport Area ventilation building 7 will be located above grade. The design criteria of not exceeding 70 dBA will be achieved at this location for both daytime and nighttime hours. All of the design work, in order to comply with the DEP noise requirements, will be performed during the Section Design Phase of the project, with projectwide criteria being written into the contract to provide for consistency in engineering analysis.

5.2.3 Noise At Tunnel Portals

Noise impacts at tunnel portals are not expected to be substantial for the following reasons. At peak periods, vehicle speeds will be slower and the bank of vehicles in full lanes of traffic leaving or entering the portal will not create a sudden and substantial increase in air pressure at the portal. At off-peak periods, though vehicle speeds will be higher, the frequency of vehicles entering or leaving the portal will be lower. In order to have a substantial noise impact at the portal, a sudden and high increase in air pressure would have to be generated by a bank of vehicles in full lanes of traffic travelling at high speed (i.e., 60 mph). This condition is not expected with the Proposed Action.

5.3 MITIGATION MEASURES: NOISE

An area or land use must be considered for noise abatement if the predicted traffic-related noise levels either approach or exceed the FHWA noise abatement criteria or substantially exceed existing levels. Either of these two conditions represents a noise impact. Abatement measures are to be considered to the extent that reasonable opportunities exist to control noise.

Achieving the requirements of the FHWA standards does not guarantee the elimination of annoyance or disturbance from traffic noise even in those situations where the noise abatement criteria are met. These noise abatement criteria are established for various activities or land uses, which represent the upper limit of acceptable traffic noise conditions, and are used to determine the noise impact on human activities. Occasional peak noises, such as those that occur with the passage of a few trucks per hour, will not be fully controlled.

Abatement measures that could be used to mitigate traffic noise impacts include:

- o traffic management procedures
- o alteration of roadway horizontal and vertical alignments
- o noise insulation or soundproofing of public use or nonprofit institutional structures
- o acquisition of property for buffer zones
- o installation of noise barriers within the right-of-way

Traffic management measures are sometimes feasible for noise abatement. Such measures include limiting the highway to automobiles and medium trucks and prohibiting heavy trucks, which would produce substantial noise benefits. Such a prohibition is not possible for the

Proposed Action, because the new roadway is designed as a major route for the movement of all classes of vehicles. Noise barriers were also considered for these sites and were found unreasonable.

Alterations of roadway alignment would require redesigning the highway by moving it away from sensitive receptors. To the extent possible, these measures have already been incorporated in the design of the proposed alignment, and the roadways will be enclosed in critical areas.

Acquisition of property for buffer zones can reduce noise impacts, where unimproved property exists between noise-sensitive receptors and roadway corridors. No such opportunity exists along the alignment for the viaducts, at-grade sections of the project, or associated cross roads and ramps.

Consequently, the only reasonably available abatement measures consist of erecting noise barriers within the right-of-way or providing noise insulation for public use or nonprofit institutional structures in critical areas where the project noise levels approach or exceed the relevant FHWA noise abatement criteria. Noise abatement measures should provide a substantial reduction in noise levels, should be cost effective, and should be implementable in a practical manner without limiting accessibility.

5.3.1 Noise Barrier Analyses

The amount of noise reduction that a noise barrier can achieve and the cost of a barrier are two factors in determining noise barrier feasibility. To be considered effective, a barrier should reduce noise by approximately 10 dBA. The Department uses the concept of cost per decibel reduction per dwelling unit, i.e., a barrier costing approximately $2,400 or less per dBA reduction per dwelling unit is considered practical. In this analysis, it is assumed that the cost of a barrier is $14 to $17 per square foot. Noise barriers have been considered where the total projected traffic noise levels approach or exceed the relevant FHWA noise abatement criteria (NAC) at all sites with external use, except sites 10, 13, 29B, and 37. (At these four sites there will be no noise impact.)

The following addresses the feasibility and reasonableness of placing noise barriers at all Category B sites where projected noise levels approach or exceed the NAC of 67 dBA. Noise barriers are recommended at only two of these sites (30 and 36).

5.3.1(a) Area North Of Causeway Street

At site 17 (Edward Everett House), even though the project would exceed the NAC by 1 dBA, noise barriers are not recommended. This is because noise barriers are not practical here. Theoretically, a reduction of approximately 10 dBA could be achieved with two barriers: a 16-foot barrier placed along New Rutherford Avenue and a 10-foot barrier along Harvard Street (see Figure 5.2). The total length of both barriers would be approximately 1,000 feet and cost approximately $240,000. However, the barrier on New Rutherford Avenue cannot be continuous because of the intersecting side streets. These discontinuities in the barrier would result in a serious degradation of the effectiveness of the 16-foot-high barrier on the noisier side of the site. In addition, the Proposed Action noise levels will be lower than the future baseline noise levels.

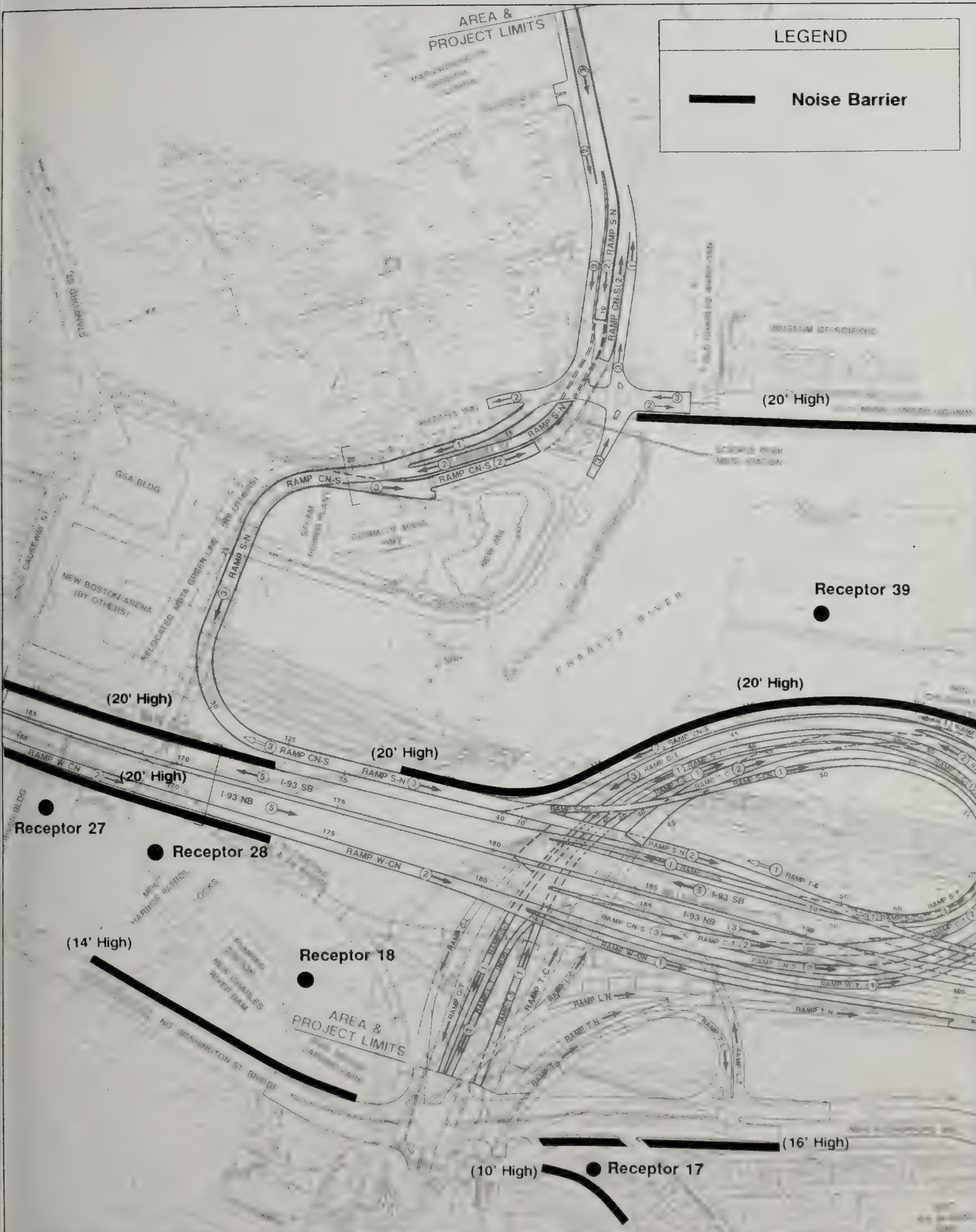

FIGURE 5.2

Location Of Noise Barrier Analyses - Area North Of Causeway Street

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

At site 18 (Paul Revere Landing Park, North Bank),the project noise levels show a decrease of 1 to 2 dBA relative to the future baseline noise levels. Also, the predominant noise sources are traffic on I-93 and the Charlestown bridge, both of which are more than 200 feet away from the site. In addition, the above roads are 20 to 75 feet higher in elevation than the receptor site. Barriers at such heights and distances are not acoustically effective. Barrier analysis for this site shows that only a meager 5-dBA reduction is attainable even with a 14-foot-high barrier on all the roadways (I-93 north- and southbound and the Charlestown bridge) (see Figure 5.2). Each of the three barriers would be at least 1,000 feet long and 14 feet high. Estimated cost of the three barriers is $680,000. Barriers are not recommended for this site because they are neither reasonable nor feasible.

At sites 27 and 28 (Charles River Building and Paul Revere Landing Park, South Bank), Proposed Action noise levels would be over 71 dBA. However, this noise level is less than future baseline noise level by 1 to 3 dBA and is generated by both north- and southbound lanes of I-93. In the vicinity of these receptors, the Central Artery emerges from a tunnel at Causeway Street and continues on an elevated section reaching a height of 40 feet above these receptors. A 9- to 10-dBA noise reduction is achievable at receptor site 28, with a 1,000-foot-long and 20-foot-tall barrier on the elevated Central Artery. However, noise levels at receptor site 27 would be reduced by only 7 dBA with the barrier, therefore not meeting the 10 dBA reduction criterion (see Figure 5.5). At an estimated cost of $340,000, a massive barrier of these dimensions on an elevated section is not considered feasible and therefore not proposed.

Site 39 (North Point, Cambridge) is currently not noise sensitive. However, this area may be developed in the near future with noise sensitive uses. Noise impact at this site will be due mainly to noise generated by traffic on north- and southbound ramps of the CANA loops and non-project-related traffic on the old Charles River dam (O'Brien Highway). Adequate consideration would be given to the feasibility and reasonableness of the barriers when the future developments planned for this area are finalized and the required permits and other applications are approved. At this time, however, noise barriers are not proposed.

5.3.1(b) Central Area

Receptor sites 15, 16, and 25 [Waterfront (Columbus) Park] are in the same general area. At sites 15 and 25, the Proposed Action noise levels are perceptibly lower than the future baseline noise levels. At site 16 the Proposed Action would increase the noise level by 1 dBA relative to the future baseline noise level. A reduction of 9 dBA can be achieved at all three sites with a 12-foot-high barrier alongside the edge of the park along the Surface Artery and Atlantic Avenue. The total length of the barrier would have to be approximately 1,000 feet to effectively mitigate the noise levels inside the park (see Figure 5.3). It is estimated that such a barrier would cost approximately $204,000. However, a barrier along the park edge would obstruct the view of the Harbor from Quincy Market. Also, a 1,000-foot-long continuous barrier would pose serious accessibility problems to the park. For these reasons, this barrier is not recommended.

At site 21 (Quincy Market) the Proposed Action noise levels are marginally lower than the existing noise levels and up to 2 dBA less than future baseline noise levels. A reduction of approximately 10 decibels could be achieved with a 700-foot-long, 10-foot-high barrier. The barrier would be 200 feet long on the edge of Clinton Street and 500 feet long on the shoulder of Surface Road in front of Quincy Market, as both of these streets generate the

noise levels at the site (see Figure 5.3). The estimated cost of this barrier is $175,000. The proposed barrier would obstruct the view of the Harbor. Its intrusion upon the Market Place Center and Quincy Market would be substantial and thus a barrier at this site is not recommended.

Proposed Action noise levels inside apartments with open windows at site 22 (Harbor Towers) are predicted to be 5 dBA over NAC, or 3 to 4 dBA quieter than the future baseline noise levels. A practical-sized noise barrier would protect only the ground level receptors (where there are no apartments) not the units at upper levels. In addition, noise received at this site is primarily from surface traffic and not generated by the project. Therefore, a noise barrier is not recommended at this site as it would be ineffective.

At site 3 (Dockside Place), a condominium apartment building near the Children's Museum and associated open space, the Proposed Action noise levels are estimated to remain at about the same level as the baseline noise level. This site is at a distance of approximately 400 feet from the Proposed Action. (This site was considered in the 1985 FEIS/R when the Preferred Alternative was in a different and closer alignment). Noise levels received at this site are generated primarily by surface traffic in the area and not related to the project. No barrier is proposed for this site.

At site 4 (Boston Tea Party Museum), where the Proposed Action noise levels are 1 to 2 dBA less than future baseline noise levels, a 10-foot-high, 375-foot-long barrier has been considered. This barrier could be constructed on the north side of Congress Street, on the edge of the affected site. A 10-dBA noise reduction is achievable. Although such a barrier is feasible, its construction is not reasonable because noise at this site is not generated by the Proposed Action. The site is a museum of historical importance and needs to be visible from all directions. A noise barrier is not recommended.

5.3.1(c) I-93/I-90 Interchange And Massachusetts Avenue Interchange Area
Noise received at site 1 (Rotch Playground) is generated primarily by traffic on Albany Street and on the southbound lanes of I-93. Albany Street is at the same elevation as the playground, whereas I-93 is approximately 20 feet higher and is located further away from the playground. At this site, where the Proposed Action would increase the noise level by 1 decibel relative to the future baseline noise level, a reduction of 7 dBA could be achieved with a 20-foot-high barrier along the three sides of the playground closest to Albany Street. The total length of the barrier would be approximately 700 feet and the estimated cost is $240,000 (assuming $17 per square foot). In addition to the wraparound barrier, a 14-foot-tall structural noise barrier on the western edge of I-93 was considered. An additional 3-dBA noise reduction is achievable with the additional barrier on I-93 (see Figure 5.4), with a total reduction of 10 dBA. Because of the size of the unusually tall (20 feet) barriers which result in only a 7 dBA reduction, and their adverse visual impacts on and potential reduced safety for park users, barriers are not considered reasonable and hence they are not proposed for this site.

At site 36 (Hudson Street), where the Proposed Action noise levels are predicted to be 2 dBA higher than NAC, an 850-foot-long, 10-foot-high barrier would reduce the noise level by 10 dBA (see Figure 5.4). Ground level receptors (approximately 8 residential units) in 12 multifamily structures would be protected at a total estimated cost of $145,000. Since the barrier would be cost effective, the barrier is recommended.

FIGURE 5.3

Location Of Noise Barrier Analyses - Central Area

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
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SUPPLEMENTAL EIS/R

0 100 200 400 800
FEET

FIGURE 5.4 **Location Of Noise Barrier Analyses - I-93/I-90 Interchange And Massachusetts Avenue Interchange Area**

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

0 100 200 400 800
FEET

FIGURE 5.5

Location Of Noise Barrier Analyses - South Boston And South Boston Bypass Road Area

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

5.3.1(d) South Boston/South Boston Bypass Road Area

At site 34 (Flaherty Park), where a moderate impact is predicted, various acoustically feasible options have been considered. These options included a 12-foot-high, 500-foot-long continuous barrier, a wraparound barrier for the three sides of the park, and a 250-foot-long lid over the depressed portion of the South Boston Bypass Road near the park. None of the above options is reasonable because: a long, continuous barrier would block side streets; a wraparound barrier would create visibility problems; and the cost of the lid over the roadway would be excessive. As part of the South Boston Haul Road project, the Department will implement a suggestion of the City of Boston and construct a 12-foot-high visual barrier between the roadway and the park. This barrier will maintain the open characteristics of the park, separate the park from the roadway, and provide some noise attenuation for park users.

In the area of site 35 (31 West Fifth Street) where a moderate impact is predicted, approximately 30 apartment units, in six multi-family buildings, are within 200 feet of the South Boston Bypass Road between Dorchester Avenue and Second Street. All of the apartment buildings have usable external areas for recreation and other outdoor activities. Five units are ground level receptors next to the proposed project. Barriers are not recommended, however, since they would be ineffective and not cost effective. Theoretically, a 15-dBA reduction in noise levels could be achieved with 1,000-foot-long, 15-foot-high uninterrupted barriers at an estimated cost of $170,000 (see Figure 5.5). However, it is infeasible to construct continuous barriers at this site due to openings in it to allow traffic flow on all cross streets. As part of the South Boston Haul Road project, the Department has agreed to monitor noise levels at this location and review noise mitigation measures if warranted.

5.3.1(e) East Boston/Logan Airport Area

For sites 11 and 30 (at heavily used baseball and football fields at East Boston Memorial Stadium Park), the Proposed Action noise levels would be 3 to 5 dBA higher than the noise abatement criterion level of 67 dBA. A 1,700-foot-long, 16-foot-high noise barrier would provide an 11-dBA noise reduction at an estimated cost of $460,000. The barrier is proposed to be built on the eastern, southern, and northern boundaries of the East Boston Memorial Stadium Park (see Figure 5.6). Subject to community review, construction of this barrier is feasible and reasonable and is recommended.

5.3.1(f) Other Sites

Sites where external noise sensitive land use is not involved or sites which are partially shielded from external activities (FHWA activity Category E sites) include: 6-9, 12, 19, 20, 22, 23, 26, 31-33, 36, and 38. For these indoor sites, a traffic noise impact has been identified with open windows. Feasible and reasonable noise abatement measures will reduce the traffic noise impact at these sites. A final decision on the type of abatement measures will be made upon completion of the project design and the public involvement process.

Sites 14 and 29A are not noise sensitive. No mitigation is required at sites 2, 5, 10, 13, 14, 24, 29A, 29B, and 37.

5.4 COMPARISON WITH FEIS/R: NOISE

Changes in the alignment, including placing roadway sections in South Boston and East Boston

in tunnels and the addition of HOV lanes in South Boston, have been analyzed and their impacts are assessed in this SEIS/R (see Chapter 3). Additional noise-sensitive sites have been included in the project area. New measurements are reported at all of the monitoring sites to truly reflect the existing noise levels in the project area. The existing baseline noise levels have increased by less than 3 dBA at some locations in the time period between 1982/83 (when the FEIS/R was prepared) and 1989. Flaherty Park in the South Boston area has been identified for noise mitigation; this park was not affected by the Preferred Alternative in the FEIS/R.

5.5 AFFECTED ENVIRONMENT: VIBRATION

Vibration-sensitive land uses in the project area include residential, commercial, institutional, and industrial buildings, existing MBTA subway tunnel structures, and Section 4(f) properties (parklands, recreation areas, and significant historic or archaeological resources). The potential effects of vibration at such locations include structural damage, annoyance to building occupants, and/or interference with sensitive manufacturing processes. These concerns would be greater during the construction phase than during the operations phase of the Artery/Tunnel Project (see Chapter 20).

5.5.1 Existing Vibration Levels

The basic vibration descriptor used in this study is the "peak vibration velocity" expressed in inches per second (in/sec). The peak velocity has been found to correlate well with structural damage, human vibration perception, and interference with operation of sensitive equipment. For example, vibration with a peak velocity of 0.005 in/sec (perception threshold) would be just barely noticeable to humans, but could be disruptive to the operation of some sensitive precision instruments. Vibrations 10 times the perception threshold would be strongly noticeable, while vibrations 100 times the perception threshold would be characterized as "very unpleasant," and vibrations 1,000 times the perception threshold would be intolerable to humans and would be likely to cause minor damage to buildings. (Vibration levels generated by typical activities and vibration criteria applicable to this project are summarized in Table 5.18.)

Vibration measurements were made during April and June 1982, April 1983, July 1988, and March 1989 to document the existing vibration levels at 19 locations (see Figure 5.7). (Description of these locations and measured vibration levels are presented in Table 5.19.)

Results of the vibration measurement program indicate a wide range of existing vibration levels. The measurement results in the vicinity of the Central Artery at sites E through R (Table 5.18) indicate that in most cases maximum existing peak vibration velocities fall between 0.01 and 0.10 in/sec. These velocities are within the perceptible to strongly perceptible range, and are caused principally by motor vehicle traffic on surface and elevated roadways. At site J (Spaulding Rehabilitation Hospital), measured peak ground vibration velocities due to commuter train movements also falls within this range, with the exception of one event. This event consisted of an MBTA commuter train movement on the track closest to the measurement position (15 feet) and resulted in a peak velocity of 0.47 in/sec.

FIGURE 5.6

Location Of Noise Barrier Analyses - East Boston/ Logan Airport Area

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

FIGURE 5.7

Vibrations Measurement Locations

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

0 800 1600 2400 3200 Feet

Table 5.18

PROJECT VIBRATION CRITERIA[1]

Type of Effect	Maximum Peak Vibration Velocity[2] (in/sec)
Damage Effects	
Structural Damage	1.900[3]
Architectural Damage	
Historical Buildings	0.120[4]
Nonhistorical Residential Buildings	0.200[5]
Annoyance Effects	
Hospital and Critical Areas	0.005[6]
Residential/Institutional/Hotel	
Construction Period	0.010[6]
Long Term	0.007[6]
Office	0.020[6]
Factory	0.040[6]

1. Maximum existing vibrations serve as supplementary criteria to the values listed in this table
2. Refers to ground vibration in the case of damage effects and building vibration in the case of annoyance effects
3. Commonwealth of Massachusetts - safe blasting limit 527 CMR 13.11
4. German Institute For Standards, DIN 4150, March 1983
5. Jackson, M.W., International Symposium on Wave Propagation and Dynamic Properties of Earth Materials, University of New Mexico, 1967
6. ANSI Standard S3.29-198X

Table 5.19

SUMMARY OF EXISTING VIBRATION MEASUREMENT

Sites[1]	Description	Range of Peak Vibration Velocity (in/sec)	Major Vibration Sources
A	Sidewalk outside 144 Bremen Street, above the Blue Line subway tunnel	0.020 - 0.060	Subway trains
B	Ceiling inside MBTA Red Line subway tunnel below Fort Point Channel	0.014 - 0.042	Subway trains
C	Ceiling inside MBTA Blue Line subway tunnel below Porter Street (East Boston)	0.016 - 0.095	Subway trains
D	Floors inside Gillette Company buildings (South Boston)	0.004 - 0.031	Normal building activities
E	Sidewalk outside Bain Building at 394 Atlantic Avenue	0.011 - 0.066	Street traffic, foot-steps, building construction
F	Sidewalk outside building at corner of State Street and Surface Artery	0.011 - 0.056	Street and expressway traffic, footsteps
G	Sidewalk outside North Market Building at Quincy Market, near corner of Clinton and Commercial Streets	0.010 - 0.027	Motor vehicles and pedestrian traffic
H	Sidewalk outside North End Nursing Home, at building corner nearest Richmond Street and Callahan Tunnel portal	0.010 - 0.040	Motor vehicle and pedestrian traffic
I	Sidewalk outside apartment between 2 and 3 Stillman Place on east side of expressway (North End)	0.007 - 0.016	Street and expressway traffic

Table 5.19 (Cont.)

SUMMARY OF EXISTING VIBRATION MEASUREMENT

Sites[1]	Description	Range of Peak Vibration Velocity (in/sec)	Major Vibration Sources
J	Ground outside new wing of Spaulding Rehabilitation Hospital, approximately 15 feet from nearest North Station railroad track	0.017 - 0.470	Commuter train movements
K	Fur Merchants Warehouse - on the floor in basement 717 Atlantic Avenue	0.0013	Not identifiable
L	Outside Fur Merchants Warehouse - on sidewalk on Atlantic Avenue	0.0014	Light vehicular traffic
M	South Station building - on basement floor of telephone cable room	0.0003 - 0.001	Light vehicular traffic
N	South Station building - 2nd location on basement floor within 50 feet of Atlantic Avenue	0.001	Light vehicular traffic
O	118 Blackstone Street (on the basement floor of bakery within 50 feet of Blackstone Street)	0.002	Light vehicular traffic
P	Corner of Kneeland and Hudson Streets (on sidewalk outside Sleepworks)	0.0024	Light vehicular traffic
Q	Basement of Sleepworks building facing Kneeland Street	0.002	Light vehicular traffic

Table 5.19 (Cont.)

SUMMARY OF EXISTING VIBRATION MEASUREMENT

Sites[1]	Description	Range of Peak Vibration Velocity (in/sec)	Major Vibration Sources
R	At-grade entranceway to Sleepworks building	0.002	Light vehicular traffic
S	House of Bianchi basement (293 A Street)	0.028-0.088	Heavy truck traffic within 10 to 15 feet

1. See Figure 5.2 for location

Source: FEIS/R (Sites A-J)
Bechtel/Parsons Brinckerhoff (Sites K-S)

In the absence of major identifiable vibration sources, the minimum peak ground vibration velocities at sites E through R range between 0.001 and 0.005 in/sec, generally not perceptible to barely perceptible. Peak vibration velocities at site S (basement of House of Bianchi) lie in the range 0.028 in/sec to 0.088 in/sec. These high levels are caused by heavy trucks on A Street, but are well below the criteria for architectural or cosmetic damage for nonhistoric buildings.

Sites A through C present vibration levels near Blue Line and MBTA tunnels registering between 0.014 and 0.095 in/sec during the passage of subway trains. Site D shows vibration velocities caused by normal building activities in a manufacturing facility, and the levels lie in the range 0.004 to 0.031 in/sec.

5.6 ENVIRONMENTAL CONSEQUENCES: VIBRATION

5.6.1 Vibration Impacts

The severity of vibration effects is assessed by comparing anticipated long-term vibrations at sensitive receptors with existing vibration levels and with project vibration criteria.

Potential long-term groundborne vibration effects of the Proposed Action are due to vehicular traffic. The vibration velocity levels that would result in architectural damage are in the range of 0.12 in/sec for historic structures and 0.2 in/sec for nonhistoric structures. Typically, a heavy truck passing by will generate a velocity level in the range of 0.003 in/sec, considerably lower than the damage criterion of 0.12 in/sec. As a result, future traffic vibrations will not cause even minor damage to historic and nonhistoric structures.

Traffic-generated vibration could be annoying to people inside buildings. Annoyance would be greatest near roads that are in poor condition and that carry high volumes of heavy trucks. Ground vibration reaches its peak level with the passage of an individual vehicle. Increased traffic volumes do not increase the magnitude of ground vibration, but rather increase the number of peaks associated with the passage of each individual vehicle in a given time period. Therefore, the effects of traffic vibration is assessed based on the maximum amplitude of the vibration caused by a single vehicle rather than on traffic volumes. Typically, vehicles at 50 feet generate vibration velocities in the range of 0.001 in/sec for automobiles to 0.003 in/sec for trucks. The criteria for annoyance and disruption of sensitive equipment are in the range of 0.005 in/sec for hospitals and 0.04 in/sec for factories. These levels are higher than the vehicle-generated levels and will not be exceeded by the Proposed Action.

5.7 MITIGATION MEASURES: VIBRATION

The Proposed Action will have beneficial effects with reduced levels of vibration as compared to the existing and future baseline conditions at all locations near the existing Central Artery. No adverse long-term vibration effects are anticipated from the Proposed Action, and, therefore, no mitigating measures are required. In fact, some long-term benefits are expected after the existing Central Artery viaduct is dismantled. In

particular, at locations near existing Central Artery columns, where traffic vibrations are now noted, they are expected to become imperceptible.

No vibration impacts are anticipated from the operation of the ventilation building equipment as isolators will be provided for all of the rotating and associated equipment to satisfy the ground vibration criteria.

5.8 COMPARISON WITH FEIS/R: VIBRATION

To properly assess the vibration impacts as a result of extending the project limits and changing the alignment (especially the change from Fort Point Channel to Atlantic Avenue), more sensitive receptors were included in the present analysis as compared to the 1985 FEIS/R. The vibration impacts were consistent in that no major impacts due to operation of the Artery/Tunnel Project were anticipated for either the FEIS/R or the SEIS/R.

5.9 RESOLUTION OF ISSUES RAISED BY PUBLIC AGENCIES

Some of the issues raised by FHWA, DEP, and the City of Boston are addressed in the following paragraphs. Responses to the comments have been incorporated in the appropriate sections of this chapter.

An analysis of noise abatement measures is presented with a site-by-site discussion of the feasibility and reasonableness of the proposed noise abatement measures. An interior noise level criterion of 52 dBA is adopted for Category E sites, which are characterized by an absence of exterior land use or sites which are shielded from exterior noise levels. For some of these sites open window conditions are assumed and for the others closed window conditions are assumed. A 10-dBA noise reduction for open windows is used in the analysis, which is generally accepted as the open window noise reduction for building exterior walls having a 4 percent area of open windows.

For ventilation buildings, the property line criterion of 65 dBA will be more stringent than the 50-dBA nighttime noise level in areas where noise sensitive land uses are situated, at a distance of more than 100 feet from the ventilation building property line.

In the absence of an accepted or standardized methodology for assessing the cumulative effects of traffic-induced vibration and lack of a suitable procedure to compare them with design criteria levels, peak vibration velocity levels generated by individual vehicle movements were used to assess the potential vibration impacts during the operations phase of the proposed development.

Chapter 6 – Energy

Chapter 6
ENERGY

This chapter quantifies the direct and indirect energy expenditures associated with the Artery/Tunnel Project. Existing energy consumption levels are provided as the basis for comparison with project-related impacts. The energy impacts of the project are described and compared with projected 2010 baseline conditions. The chapter concludes with mitigation measures and a comparison of the impacts described here with those described in the FEIS/R.

The Artery/Tunnel Project will result in a net annual energy savings of 329,476 equivalent barrels of oil (Bbl). While project construction will require a substantial, onetime energy expenditure, this expenditure will be offset by savings in direct energy consumption in 7 years.

6.1 AFFECTED ENVIRONMENT

Vehicular Fuel Consumption. The Artery/Tunnel Project traffic analysis indicates that under existing (1987) conditions, total vehicle miles travelled (VMT) for all vehicles operating within the traffic network was 1,284,474,628 miles per year. Annual fuel consumption by those vehicles totalled 1,811,435 Bbl.

Roadway Support Facilities. Data on current energy consumption for roadway support facilities are not available. Existing support facilities include roadway lighting on the Central Artery, and ventilation and drainage systems in the Dewey Square tunnel.

6.2 ENVIRONMENTAL CONSEQUENCES

6.2.1 Direct Energy Analysis

Vehicular Fuel Consumption. Table 6.1 provides estimates of total VMT and annual fuel consumption for all vehicles operating in the project traffic network for the existing condition and the two 2010 conditions. Under the Proposed Action, annual VMT is projected to be 1,747,287,103 miles, up 3.1 percent (52,552,870 miles) from the projected baseline level, and up 36 percent (462,812,475 miles) from the existing condition.

Despite this increase, projections indicate that under the Proposed Action annual fuel consumption would decrease by 16,968,278 gallons, or 15.2 percent (see Figure 6.1) less than the 2010 baseline condition because of improved traffic flow conditions. This substantial annual savings would be equivalent to 379,584 Bbl and is a direct result of increased travel speeds. Under the Proposed Action, average daily vehicle speeds within the SEIS/R traffic study area would increase by 44.2 percent. This increase would enable vehicles to operate at higher, more fuel-efficient speeds and result in substantial fuel savings, more than compensating for the increase in total VMT between the 2010 baseline and the Proposed Action conditions.

Table 6.1

ANNUAL ENERGY CONSUMPTION BY VEHICLES

	1987 Existing Condition	2010 Baseline Condition	2010 Proposed Action Condition
Annual vehicle miles travelled	1,284,474,628	1,694,734,233	1,747,287,103
Gallons consumed:			
Gasoline	72,376,430	101,622,817	84,067,039
Diesel	8,011,820	9,029,068	9,616,567
Total	80,388,250	110,651,885	93,683,607
Btus consumed (millions)	10,506,555	14,447,949	12,246,185
Bbl consumed	1,811,435	2,490,826	2,111,242

1 gallon gasoline = 130,000 Btus
1 gallon diesel fuel = 137,000 Btus
1 barrel crude oil = 5,900,000 Btus (average for all crudes)

Fuel Consumption Standards: United States Federal Highway Administration
Conversion Sources: United States Department of Energy
United States Federal Highway Administration

Source: Bechtel/Parsons Brinckerhoff

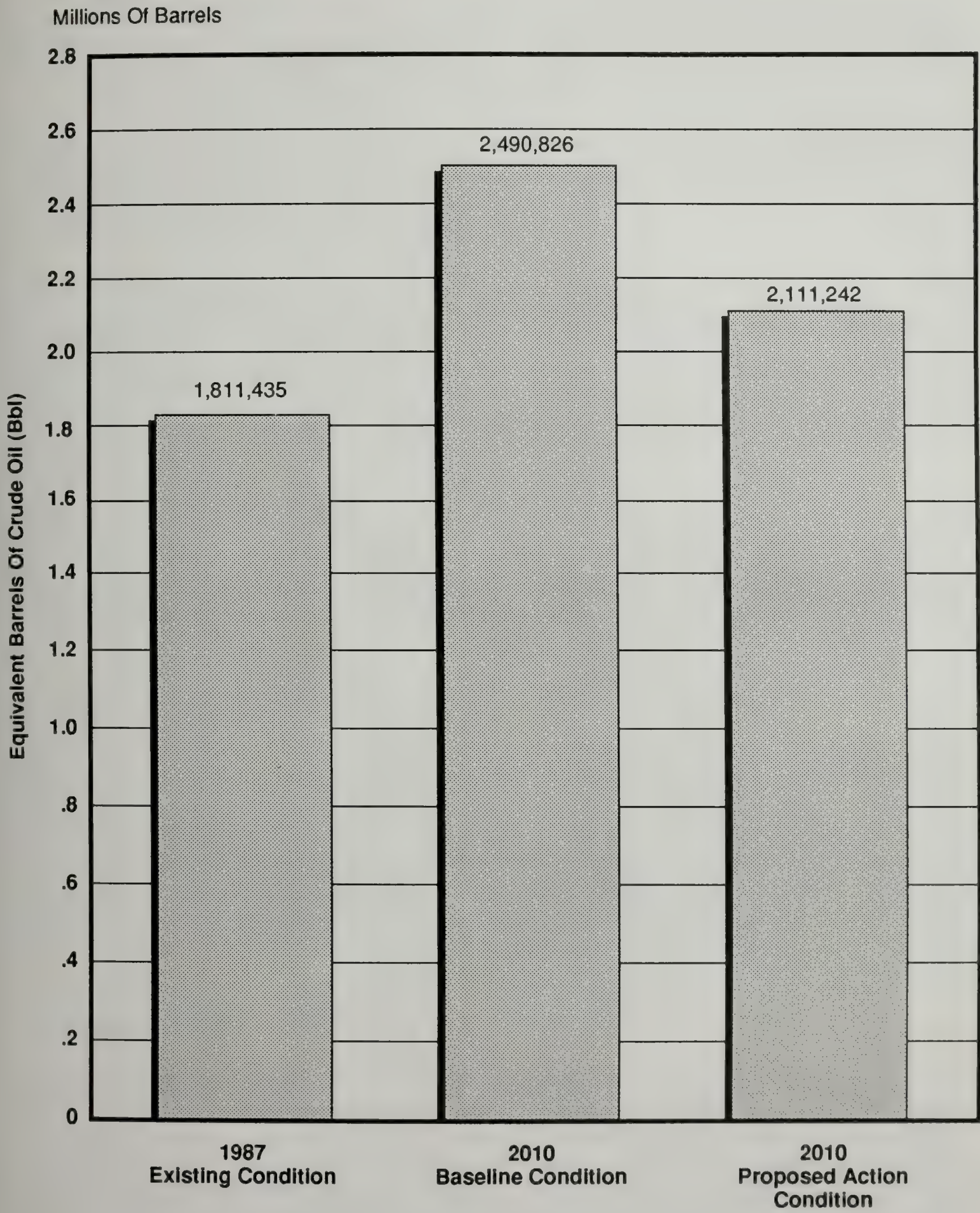


FIGURE 6.1

Total Energy Consumption By Vehicles

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

Increased fuel efficiency due to expected engine improvements in the future also contribute to the savings in direct energy. (The 2010 fuel consumption figures used in this analysis are based on U.S. Department of Energy data and indicate that the 2010 fleet will consume 23.8 percent less fuel per mile travelled than vehicles operating in 1989.)

Roadway Support Facilities. The annual energy expenditure for operating roadway and tunnel lighting, ventilation, and drainage systems under the Proposed Action is summarized in Table 6.2. Under the Proposed Action, roadway support systems would consume 2,297,000 million Btus, or 50,108 Bbl per year.

Conclusions. The direct energy analysis demonstrates that as a result of increased travel speeds, fuel consumption by vehicles operating in the study area with the Proposed Action would decrease by 15.2 percent, or 379,584 Bbl from the 2010 baseline level. However, the analysis also indicates that with the Proposed Action the equivalent of 50,108 Bbl would be used annually to maintain essential roadway support systems. Therefore, the Artery/Tunnel Project would achieve a net annual savings in energy consumption of 329,476 Bbl.

6.2.2 Indirect Energy Analysis

The results of the construction energy analysis are summarized in Table 6.3. Under the Proposed Action, a onetime, nonrecoverable expenditure of 13,000 billion Btus, or 2,292,400 Bbl, would be necessary to complete construction of the Artery/Tunnel Project.

6.3 MITIGATION MEASURES

Given that the Artery/Tunnel Project will result in a net savings in direct energy consumption, no specific mitigation measures are proposed to reduce energy consumption. However, a number of project transportation mitigation programs will help to limit fuel consumption levels (see Chapter 3). For example, the project's extensive high-occupancy vehicle (HOV) network will encourage private vehicle operators to use public transport for certain trips, while mass transit improvements will promote transit ridership. Although project construction will require a onetime, nonreversible expenditure of 2,292,400 Bbl, this expenditure will be off-set by direct energy savings in approximately 7 years.

6.4 COMPARISON WITH FEIS/R

The FEIS/R analysis integrated the results of the direct and indirect energy analyses to arrive at a "total energy" consumption figure, calculated in Bbl per day. Due to the substantial differences in the nature of the indirect and direct energy analyses in the SEIS/R, they are derived and presented separately. Onetime, nonrecoverable energy expenditures are calculated; however, they are not prorated over the expected useful lifespan of the project and then integrated into a "total energy" analysis. The SEIS/R relies on a different analysis procedure by including the energy expended on support facilities in the direct energy analysis and is, therefore, able to calculate the net savings of energy expended annually as a result of the Artery/Tunnel Project.

Table 6.2

2010 BUILD CONDITION: ANNUAL ENERGY CONSUMPTION FOR ROADWAY SUPPORT SYSTEMS IN MILLIONS OF BTU

Support System	I-90	I-93	Project Total
Roadway lighting	61,000	41,000	103,000
Tunnel lighting	573,000	248,000	822,000
Ventilation	1,096,000	838,000	1,934,000
Drainage	30,000	18,000	48,000
Btu Total (millions)	1,760,000	1,145,000	2,297,000

Source: Bechtel/Parsons Brinckerhoff

Table 6.3

INDIRECT CONSTRUCTION ENERGY CONSUMPTION 2010 PROPOSED ACTION CONDITION

Type of Construction	Number of Lane Feet	Btus Consumed (millions)	Bbl Consumed
Surface Highway	205,920	665,122	114,667
Highway on Viaduct	211,200	5,215,162	899,094
Highway in Tunnel	168,960	5,744,640	990,433
Highway in Boat Section	89,760	1,670,972	288,076
Total	675,840	13,296,307	2,292,400

Source: Bechtel/Parsons Brinckerhoff

The most important difference in the findings of the two energy analyses is that the SEIS/R shows a 15.2 percent reduction in annual fuel consumption for vehicles between the 2010 baseline and Proposed Action conditions. The FEIS/R showed a 2.2 percent reduction as a result of the Artery/Tunnel Project. This difference is because the SEIS/R analysis incorporates the effects of higher travel speeds in the study area due to upgraded roadway facilities, and increased fuel efficiency due to expected engine improvements in the future. (The FEIS/R did not analyze energy consumption for the affected environment and, therefore, the information on present energy consumption levels has no counterpart in the 1985 document.)

6.5 RESOLUTION OF ISSUES RAISED BY PUBLIC AGENCIES

There were no major issues raised by public agencies.

Chapter 7 – Economic Characteristics

Chapter 7
ECONOMIC CHARACTERISTICS

This chapter discusses the existing economic characteristics of the affected environment and the regional and local economic impacts of the Proposed Action. The Proposed Action will have significant economic benefits in terms of total jobs, household income, total business sales, net revenue to the State, retail sales, tourism spending and total value in reduced travel delay (see Table 7.17 for summary of impacts). Economic impacts during construction are discussed in Chapter 20 and the Construction Appendix. In addition, this chapter updates and expands the economic information contained in the 1985 FEIS/R.

7.1 AFFECTED ENVIRONMENT

Section 7.1 describes the existing economic conditions in the study area that will be directly and indirectly affected by the Artery/Tunnel Project. These conditions form the background against which the long-range economic impacts described in Section 7.2 and the construction impacts on the economy in Chapter 20 are measured. In addition to population and employment data, the results of a detailed land use survey conducted in the study area are described. Statistics on retail trade, office, industrial/manufacturing, residential, hotel/tourism activity, and overall accessibility are presented and compared with conditions described in the 1985 FEIS/R. Finally, recent changes are described in local economic activity or conditions since the FEIS/R in the subareas of the study area.

Economic conditions are examined in terms of three geographic areas: the metropolitan area, Suffolk County, and the study area (which is the core impact area). In addition, several other definitions of geographic areas are noted. The definition for the metropolitan area which is used in this study is the five-county area of Massachusetts, known as the New England County Metropolitan Area (NECMA). A broader definition of the metropolitan area is the Boston Consolidated Metropolitan Statistical Area (CMSA), which consists of 176 cities and towns, including all of the five-county NECMA plus areas of New Hampshire. A more restrictive definition of the Metropolitan area is the 101 cities and towns which comprise the jurisdiction of the Metropolitan Area Planning Council (MAPC). Yet another geographic area of study is the City of Boston, which comprises 96 percent of the population and employment of Suffolk County (Suffolk County includes Boston, Revere, Chelsea, and Winthrop). All of these alternative geographic areas are shown in Figure 7.1. The economic analysis in this chapter focuses on Suffolk County and the five-county NECMA in order to take advantage of the availability of updated county-level business statistics and forecasting models. In addition, economic conditions within the study area and its economic analysis subareas are discussed. These subareas are shown in Figure 7.4.

7.1.1 Changes In Regional Economy Since FEIS/R

The population of the NECMA grew from 3,662,888 in 1980 to 3,728,900 in 1987 (U.S. Census estimate), an increase of 2 percent in 7 years. The broader CMSA grew in population from

3,971,792 to 4,092,900 during that same period (U.S. Census estimate), an increase of approximately 3 percent in 7 years. The smaller MAPC area increased in population from 2,884,712 inhabitants in 1980 to 2,907,686 in 1985, less than 1 percent in 5 years. Over the same period, MAPC estimates that employment grew from 1,506,371 to 1,667,974, an increase of 10 percent.

In contrast to many other central cities, the City of Boston grew in population from 562,994 in 1980 to 573,600 in 1986, a rate of growth (1.9 percent in 6 years) similar to that of the larger (NECMA) metropolitan area (see Figure 7.2).

The varied growth rates in the differently defined metropolitan areas indicate that the outer suburbs have the highest rate of population growth. This growth is particularly evident along the Massachusetts-New Hampshire border, where Nashua, New Hampshire, is part of one of the fastest growing metropolitan areas (with Manchester, New Hampshire) in the United States. This growth is due in part to a net migration of population from elsewhere in the United States into the Boston CMSA (growth above the current "natural" rate of births minus deaths of about 1.3 percent). This represents a record reversal of an historic trend of net outward migration from the region.

Employment in the five-county New England County Metropolitan Area grew from 1,910,967 in 1980 to 2,190,597 in 1986, an increase of 15 percent (see Figure 7.3 and Table 7.1.) Regionally, the expansion of employment, coupled with a much lower rate of population and labor force growth during the 1980s, has led to unemployment rates well below the national average, while per capita income has risen to among the highest in the nation. (Massachusetts ranked third in per capita income in the U.S. in mid-1988.) The vigorous labor market and a limited supply of new housing have sharply driven up housing prices and the cost of living. Factors affecting these regional trends include the service (nonmanufacturing) orientation of the regional economy, the high density of land use and limited vacant land, the higher labor force participation rate, and demographic factors, including aging of the population, smaller family size, and lower birth rate than for the country as a whole.

In spite of favorable employment opportunities and growth in the outer suburbs, net migration into the region has been small, possibly for reasons of climate, the high cost of living, and congestion. As a result of these trends, a significant share of new labor has been supplied by a widening commutershed (the catchment area from which commuters flow in). This growth in commuting has placed steadily increasing demands on the region's transportation system, particularly the highway system.

Employment in the City of Boston represents 96 percent of Suffolk County's employment. Employment in Suffolk County grew 8 percent during the same 1980-86 period, from 569,000 to 612,000 workers. The City's employment base has been growing in services, finance, insurance, and retail trade, while declining in the manufacturing, wholesaling, and transportation sectors.

Study Area. The term "study area" refers to the core impact area. The study area for this SEIS/R has been expanded since the FEIS/R in order to measure and account for the economic effects of the Artery/Tunnel Project over a wider area. The study area was expanded south to include all of South Boston and the South Bay, Newmarket, and North

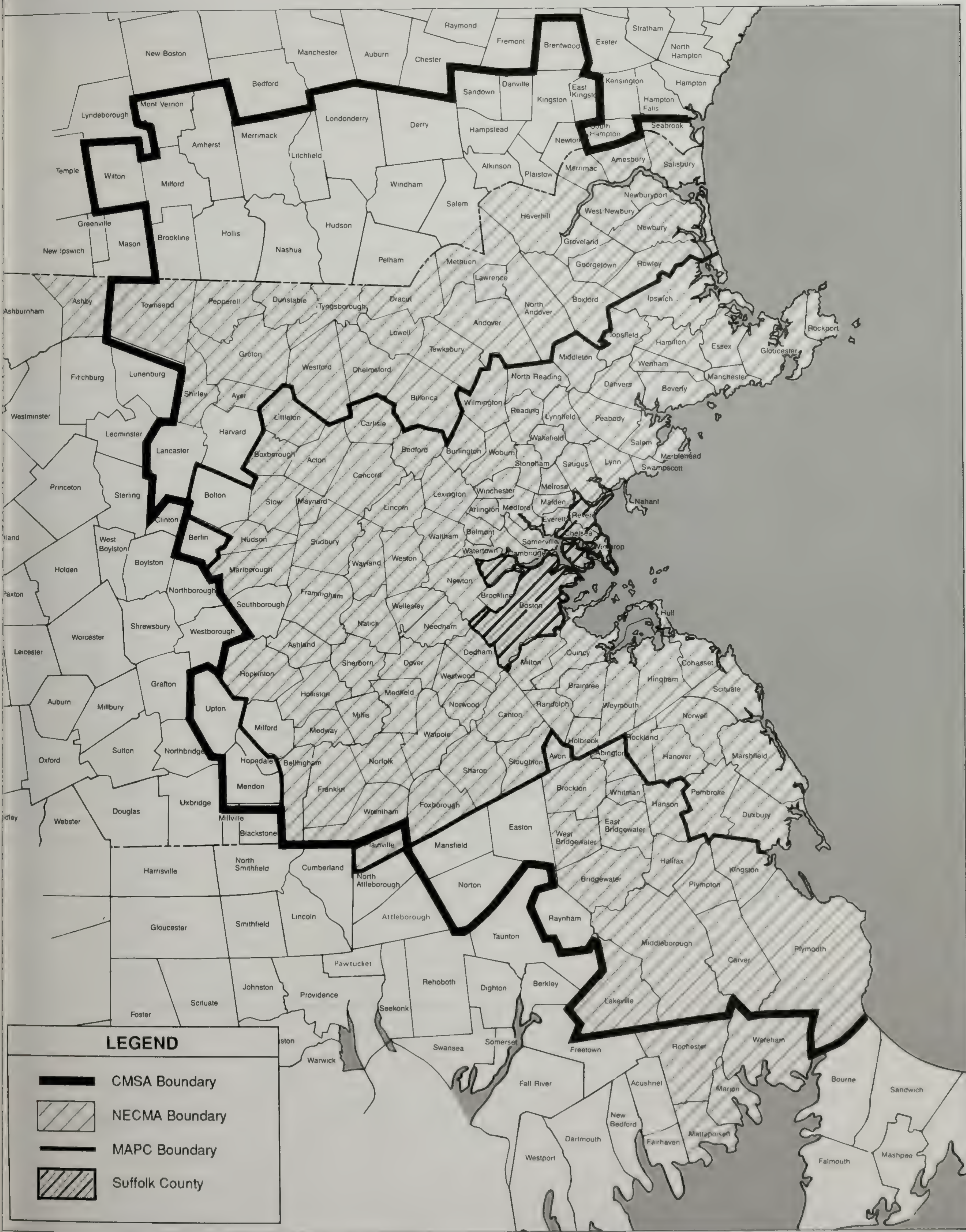


FIGURE 7.1

Boston Metropolitan Area

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

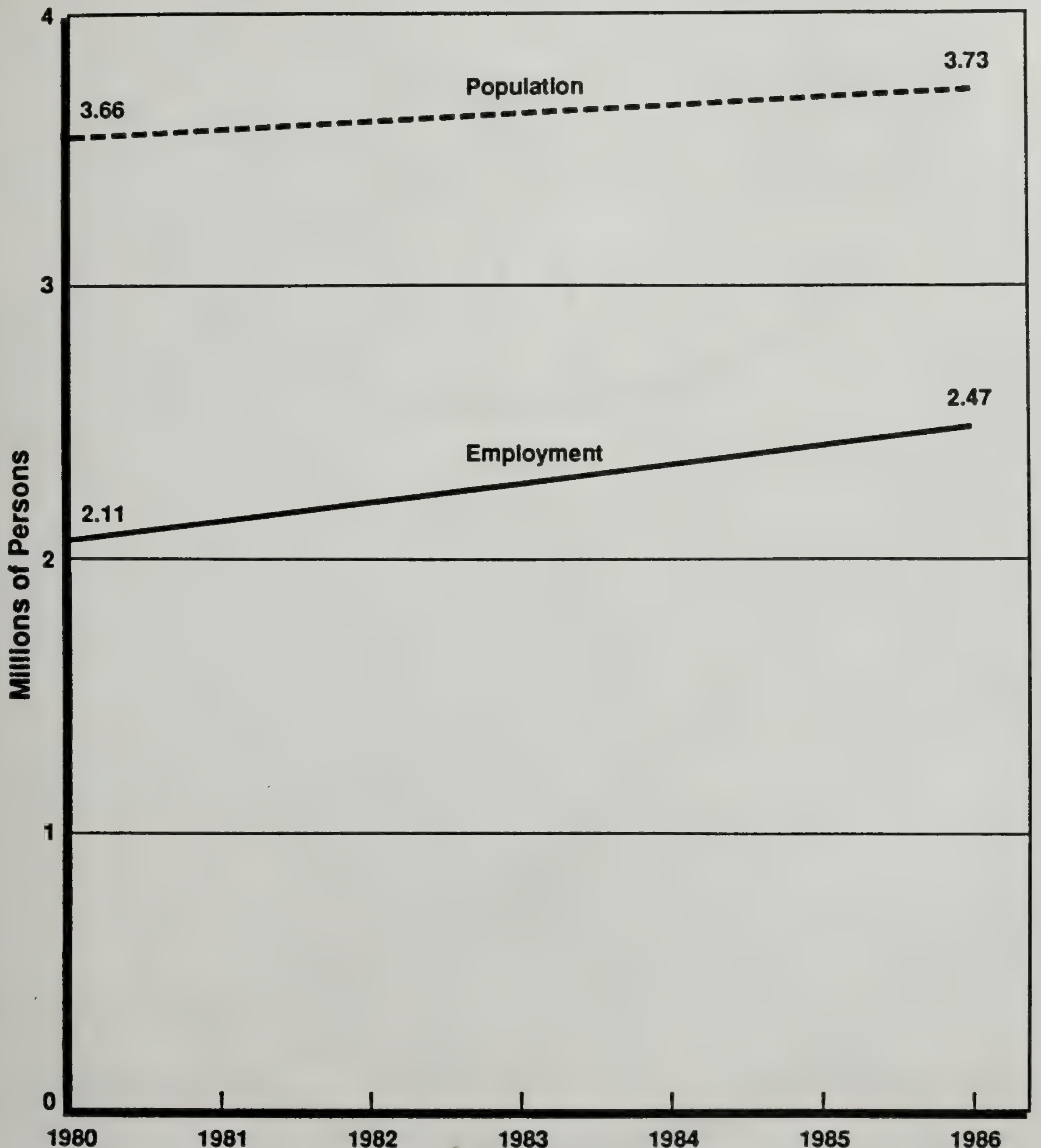
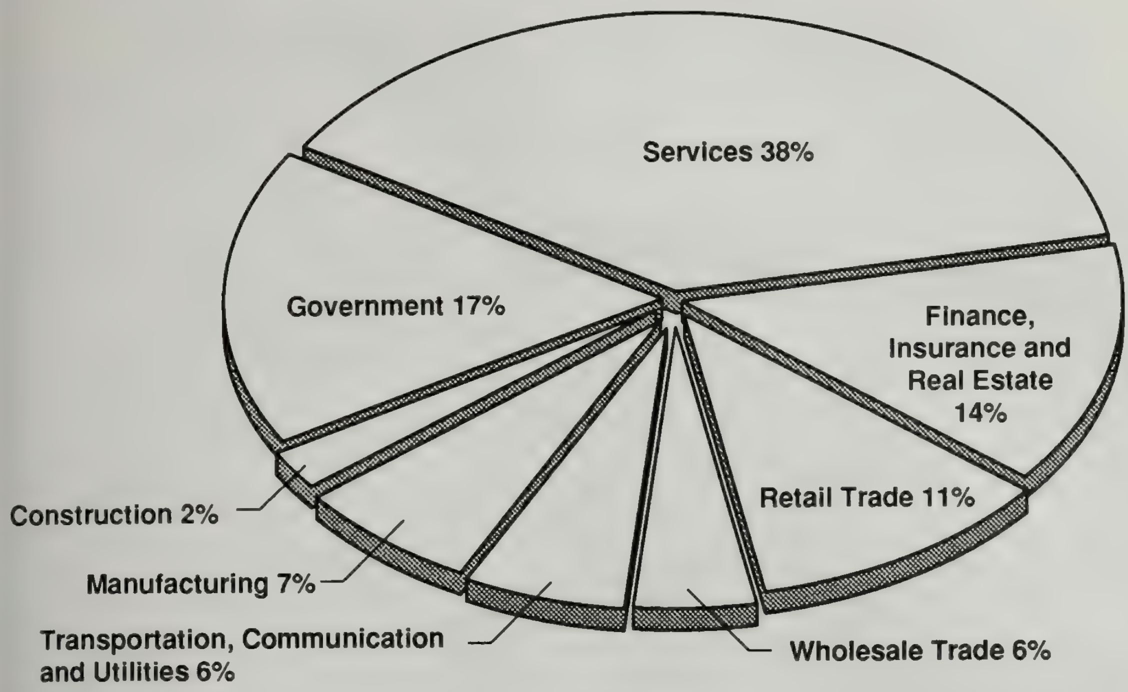


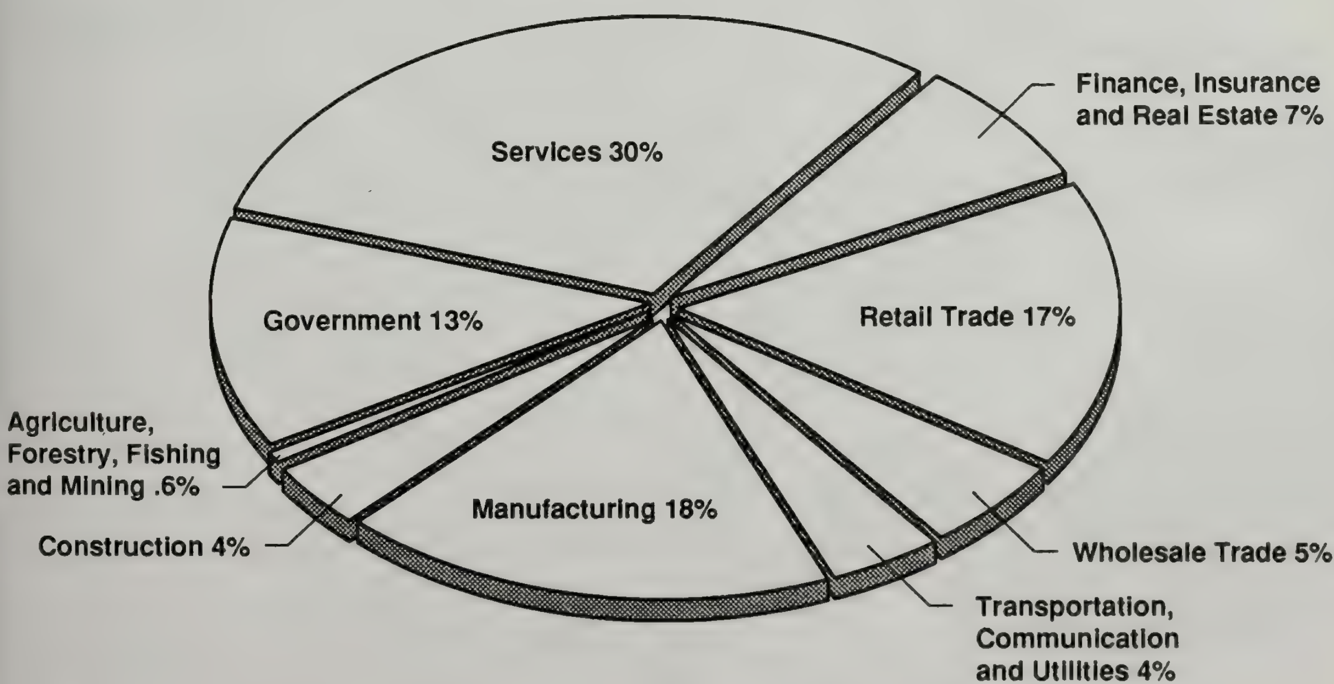
FIGURE 7.2

Population/Employment Trends In The Boston New England County Metropolitan Area

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R



Suffolk County



Five County Metro Area (NECMA)

Source: U.S. Bureau of Economic Analysis

FIGURE 7.3

Employment In The Boston Metropolitan Area

KEY

1	East Cambridge/Somerville	7	Jeffries Point/Maverick	13	Back Bay	20	Financial
2	Charlestown ex Navy Yard	8	Industrial South Boston	14	Beacon Hill	21	South Station/Leather District
3	Charlestown Navy Yard/ Constitution Plaza	9	Residential South Boston	15	West End	22	Chinatown/Bay Village
4	Eagle Hill	10	South Bay/Newmarket/ North Dorchester	16	North Station	23	Midtown Retail
5	Orient Heights	11	South End	17	Government Center		
6	Logan Airport	12	Prudential/Copley	18	North End		
				19	Waterfront		

FIGURE 7.4

Economic Analysis Subareas

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

0 1600 3200 4800 6400 Feet

Table 7.1

EMPLOYMENT IN THE BOSTON METROPOLITAN AREA

	Suffolk County[1]		NECMA[2]	
	1980	1986	1980	1986
Agriculture, Forestry, Fishing, and Mining	589	775	10,603	13,528
Construction	11,149	13,836	54,513	82,854
Manufacturing	55,307	41,658	415,007	400,887
Transportation, Communications, and Utilities	38,998	36,657	89,627	92,453
Wholesale Trade	30,214	27,713	99,128	118,027
Retail Trade	62,043	68,417	300,306	363,541
Finance, Insurance, and Real Estate	71,665	86,411	123,626	161,010
Services	196,946	233,388	515,168	665,291
Government	102,339	103,379	302,989	293,006
Total	569,250	612,234	1,910,967	2,190,597

1. Boston, Chelsea, Revere and Winthrop Town
2. New England County Metropolitan Area (Suffolk, Essex, Middlesex, Norfolk, and Plymouth Counties)

Source: U.S. Bureau of Economic Analysis, 1988 computer files

Dorchester neighborhoods, west to include the Back Bay and Prudential/Copley neighborhoods, north to include parts of East Cambridge and eastern Somerville, as well as Charlestown and the Navy Yard, and east to encompass all of East Boston and Logan Airport. Figure 7.4 shows the study area and the boundaries of its economic analysis subareas.

Direct comparisons of values reported here with numbers published in the FEIS/R should not be made because the geographic areas do not match, and several of the statistical series have recently been improved and updated. Comparisons in the following text are with data from the time of the FEIS/R, updated where possible to include the latest statistical revisions and regrouped to fit the subareas in Figure 7.4.

7.1.1(a) Population Of The Study Area

Total population in the study area increased slightly from 1980 to 1988, reversing the historical trend of population decline since 1950. City policies that encourage new residential construction and renovation have brought about some growth in all of the subareas since 1980. Areas of greatest population growth in Boston are the Central Area and Charlestown.

The 1980 U.S. Census determined the population of the study area to be approximately 179,000 residents. Census projections place the 1988 population at approximately 185,000 residents.

7.1.1(b) Employment In The Study Area

Employment in the study area has continued to grow at a substantial rate since the FEIS/R was written. Employment in 1980 is estimated by MAPC at approximately 419,000. By 1988, MAPC estimated employment to have grown to approximately 467,000, a growth of over 11 percent.

Employment for the area was estimated using several sources of data, as follows: a detailed land use survey by traffic zone for 1986, carried out for the Artery/Tunnel Project; projections of U.S. Census population data by zip code; special tabulations of U.S. Department of Commerce ("County Business Patterns") employment data by zip code; employment and population analyses by the Boston Redevelopment Authority (BRA); and census tract data for 1980 matched to traffic zones.

Land Use Survey. The land use survey was based on the most recent and available information (1986) on individual parcel uses from the Boston, Cambridge, and Somerville Assessing Departments. That information was supplemented by telephone and field research for buildings exempt from local property tax, including government-owned buildings, social service providers, religious institutions, medical facilities, and cultural, educational, and philanthropic establishments. The resulting compilation of land use by traffic zone was reviewed in detail with the BRA to extend and confirm its accuracy as a data base for the traffic analysis in this SEIS/R and for forecasting future growth trends for the study area.

Nine categories of land use were defined for the survey by grouping the Standard Industrial Codes that classify the activities taking place on the various parcels. The categories are as follows:

- o Office: including private and government office buildings and office condominiums

- o Retail: including retail stores, shopping centers, automobile dealers, restaurants, and service establishments such as banks and service stations
- o Medical: including hospitals, clinics, medical office buildings, laboratories, and other health care facilities
- o Educational: including elementary and secondary schools, colleges, universities, and day-care facilities
- o Cultural/Recreational: including museums, theaters, indoor and outdoor recreational facilities, and religious establishments
- o Industrial: including industrial and manufacturing centers, warehouse and storage facilities, communications facilities, and utility properties
- o Hotel: including hotels, motels, and inns
- o Transportation: including rail stations, bus stations, truck terminals, and vehicle storage yards
- o Residential: including residential houses, apartments, condominiums, and group living quarters such as rooming houses, dormitories, and housing for the elderly

Overall 1986 land use (in square feet of building space) determined by the survey was modified to reflect current occupancy/vacancy rates and to yield an occupied square footage for each use category within the traffic zones. These net land use figures were compared with employment estimates based on census data to determine current employment densities (employees per 1,000 square feet of occupied space) for specific types of employment and geographic subarea. The land use data for current conditions were then used as the basis for a forecast of future conditions, and future employment and traffic demand were inferred from the forecast future land use.

Table 7.2 lists study area land use and employment by subarea in 1986. Figure 7.5 shows the percent distribution of building space by type of use in the study area. Figure 7.6 compares the percentage distribution of employment in Boston by economic sector (as determined by the BRA) in 1980 and 1988. The comparison shows continued growth of the proportion of services and finance/insurance/real estate at the expense of manufacturing, wholesale trade, and transportation/ communication/public utilities. Table 7.3 shows the breakdown of employment by economic sector within zip code areas corresponding roughly to the City of Boston portion of the study area. The study area has particularly high concentrations of finance/insurance/real estate services and retail employment compared to the City as a whole and the region.

Given the existing population and participation rates in the local workforce (subtracting "reverse" commuters and employed-but-not-working), approximately 95,000 of the study area jobs can be presumed to be held by study area residents, while approximately 300,000 commuters enter the study area each day for employment.

Table 7.2

STUDY AREA LAND USE AND EMPLOYMENT (1986)

Gross Building Square Feet By Land Use

Subarea	Office	Retail	Medical	Education	Culture	Industrial	Hotel	Transport	Residen
Central	36,772,930	6,078,191	1,931,593	1,438,208	2,055,457	4,864,543	2,332,631	91,229	9,789,62
North of Causeway	3,130,397	776,465	2,422,692	935,930	791,147	3,912,109	165,550	121,880	10,912,44
South Bay/South End/Newmarket	1,711,133	1,399,928	2,507,248	548,285	357,529	5,632,617	3,080	366,766	13,650,04
Third Harbor Tunnel	3,444,237	352,465	0	24,649	608,700	11,677,034	0	182,564	123,21
South Boston/ Bypass Road	682,167	913,065	44,225	903,313	405,056	2,575,686	0	256,131	15,368,35
East Boston/Logan	545,963	1,119,014	48,800	803,660	335,980	2,282,388	324,800	232,985	13,887,47
East Cambridge/ East Somerville	8,447,127	1,669,187	17,256	7,483,739	522,069	8,801,145	1,045,539	340,562	10,191,97
Prudential/Copley-Back Bay-Beacon Hill	15,582,347	2,336,671	114,444	1,772,701	1,576,621	647,618	2,370,133	82,166	18,986,45
Total	70,316,299	14,544,986	7,086,757	13,910,485	6,652,569	40,393,140	6,241,433	1,674,203	92,901,08

Employment

Subarea	Office	Retail	Medical	Education	Culture	Industrial	Hotel	Transport	Residen
Central	150,507	16,841	6,953	2,589	2,776	7,004	2,974	91	189,73
North of Causeway	10,647	1,414	8,722	1,685	1,068	5,634	211	122	29,50
South Bay/South End/Newmarket	6,242	3,671	9,026	987	482	8,111	4	366	28,88
Third Harbor Tunnel	11,258	877	0	44	757	17,138	0	183	30,25
South Boston/ Bypass Road	2,148	2,322	160	1,626	547	3,709	0	256	10,76
East Boston/Logan	1,720	2,600	175	1,446	454	3,287	414	15,233	25,32
East Cambridge/ East Somerville	33,700	4,751	62	8,756	704	8,603	1,333	341	58,25
Prudential/Copley-Back Bay-Beacon Hill	65,998	6,613	412	3,191	2,129	932	3,021	82	82,37
Total	282,220	39,089	25,510	20,324	8,917	54,418	7,957	16,674	455,10

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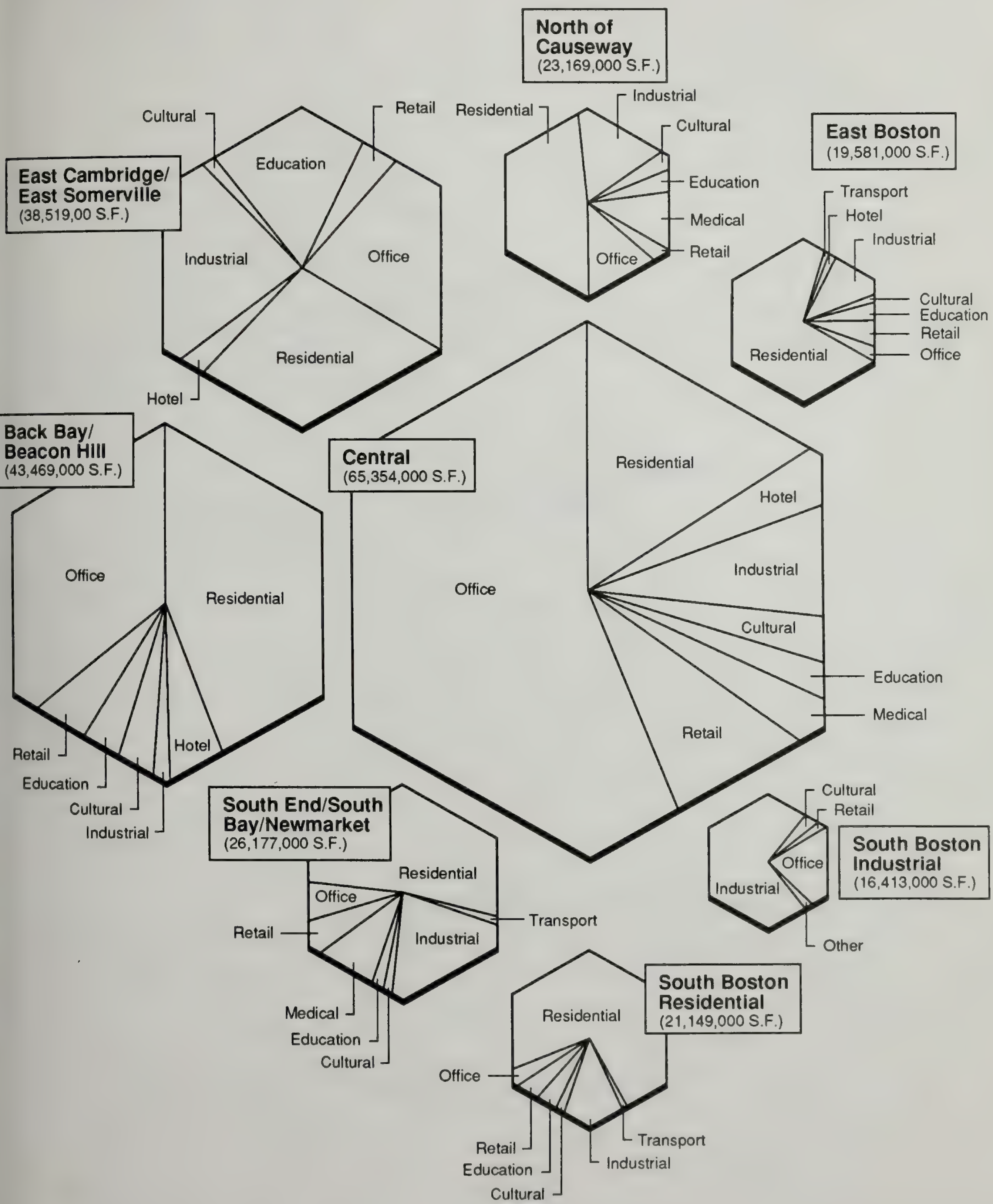
1. See Figure 7.4 for study area and subareas

Source: Cambridge Systematics, Inc., land use survey carried out for the Artery/Tunnel Project, 1988

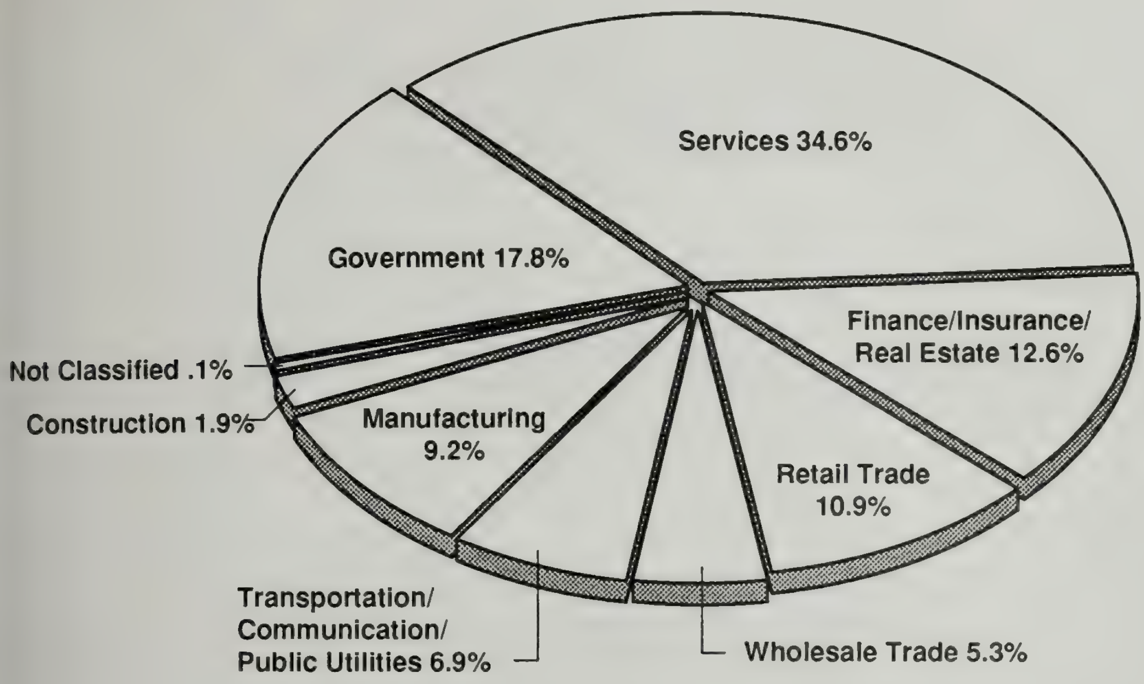


Source: Cambridge Systematics, Inc., land use survey carried out for the Artery/Tunnel I-93/I-90 Project, 1988.

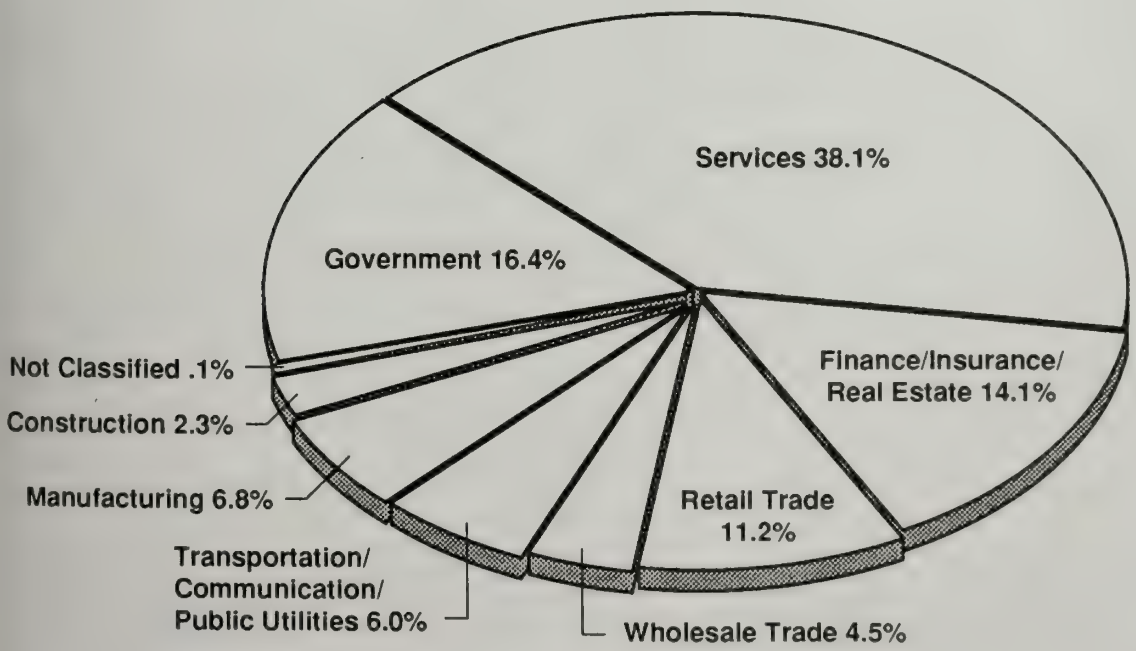
FIGURE 7.5

Distribution Of Floor Space Use In Study Area, 1987

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R



1980



1988

FIGURE 7.6

Distribution Of Boston Employment By Sector, 1980 And 1988

Table 7.3

DISTRIBUTION OF PRIVATE EMPLOYMENT BY ZIP CODES[1] IN THE CITY OF BOSTON PORTION OF THE STUDY AREA

Economic Sector	South Bay/Fort Point Channel (02210)	Prudential/ Copley/Back Bay (02115, 02116, 02215, 02199)	South Boston (02127)	East Boston (02128)	Charlestown (02129)
Agriculture	76	54	8	10	0
Construction	436	1,104	756	331	270
Manufacturing	5,572	5,427	3,735	2,212	2,233
Transportation/ Communications/ Public Utilities	494	6,582	1,451	6,463	598
Wholesale Trade	2,024	2,791	1,180	1,287	1,043
Retail Trade	1,740	17,013	1,570	2,718	1,002
Finance/ Insurance/Real Estate	2,692	11,271	433	198	107
Services	2,512	54,539	2,590	5,839	903
Government	NA	NA	NA	NA	NA
Not Classified	160	3,070	74	167	49
Self-Employed	NA	NA	NA	NA	NA
Total Private Employment (Excluding Government and Self-Employment)	15,706	101,851	11,797	19,215	6,205

(Table continued next page)

1. These zip code areas correspond roughly, not exactly, to economic subareas shown on Figure 7.4

Source: 1985 County Business Patterns Zip Code Tabulation

Table 7.3 (Cont.)

DISTRIBUTION OF PRIVATE EMPLOYMENT BY ZIP CODES[1] IN THE CITY OF BOSTON PORTION OF THE STUDY AREA

Economic Sector	Midtown Retail (02108)	Waterfront/ Financial (02109, 02110)	Chinatown/ South Station Leather (02111)	North End (02113)	Government Center (02114)	Central Area Total
Agriculture	112	27	3	0	0	142
Construction	608	388	114	20	114	1,244
Manufacturing	1,423	3,242	1,849	60	786	7,360
Transportation/ Communications/ Public Utilities	760	10,173	492	70	1,182	12,677
Wholesale Trade	551	1,971	799	94	598	4,013
Retail Trade	7,024	6,059	3,192	566	1,845	18,686
Finance/ Insurance/Real Estate	9,723	11,271	1,465	1,069	1,838	45,778
Services	22,425	54,539	15,630	1,867	13,248	89,435
Government	NA	NA	NA	NA	NA	NA
Not Classified	928	3,070	383	63	226	2,658
Self-Employed	NA	NA	NA	NA	NA	NA
Total Private Employment (Excluding Government and Self-Employment)	43,554	89,966	23,927	3,809	19,837	182,063

1. These zip code areas correspond roughly, not exactly, to economic subareas shown on Figure 7.4

Source: 1985 County Business Patterns Zip Code Tabulation

7.1.1(c) Office Space In The Study Area

Office space of all categories in the study area totalled 70 million square feet. As of December 1988, a survey of first-class office space on the market place (excluding government and owner-occupied buildings) indicated 41.2 million square feet of first-class space in the study area, of which 88 percent was occupied. This rate has recently declined slightly (from 92 percent) but still represents one of the highest occupancy rates among the nation's large cities.

In the City of Boston, nearly 20 million square feet of new private office space were constructed between 1976 and 1988 (source: Boston Redevelopment Authority and Coldwell Banker, Inc.). During 1988 alone, over 4 million square feet were added.

Similar statistics indicate that just over 55 percent of all first-class office space on the market place inside the circumferential I-495 corridor lies inside the study area shown in Figure 7.4. The study area's share of the region's new office construction has remained relatively constant since 1986.

Table 7.4 shows the types of tenants occupying the office space in downtown Boston (the Central Area). The majority of office space is occupied by insurance, finance, law firms, and other services. Offices in the study area account for approximately 282,000 employees, according to the 1986 land use survey and BRA employment data.

7.1.1(d) Retail Space And Trade In The Study Area

The scale and pace of construction of retail space also has accelerated since the FEIS/R. In the 3 years 1980 to 1982, a total of 72,500 square feet of retail space was constructed at a cost of $8 million. In the following 3 years (1983 to 1985), new retail space of over 845,000 net square feet was constructed at a cost of $129 million.

The land use survey identified approximately 14 million square feet of retail space in the project area in 1986. During 1986 through 1989, projects planned and underway comprise 985,000 square feet of retail space at a construction cost of $114 million (1985 dollars). This growth includes Market Place Center adjacent to Faneuil Hall Market Place, City Place in the State Transportation Building, and over 100,000 square feet of space in the Charlestown Navy Yard.

Gross retail sales in the City of Boston totalled $3.25 billion (1985 dollars) in 1982 (Bureau of Census, Census of Retail Trade). The BRA estimated that sales had grown to approximately $3.6 billion in 1985, about 10 percent greater than the 1982 figures reported in the FEIS/R.

During that same period, metropolitan area retail sales increased 27 percent (in constant dollar terms) to $27.7 billion. Within the study area, there are approximately 39,000 persons employed in the retail sector, with sales of roughly $2.6 billion per year.

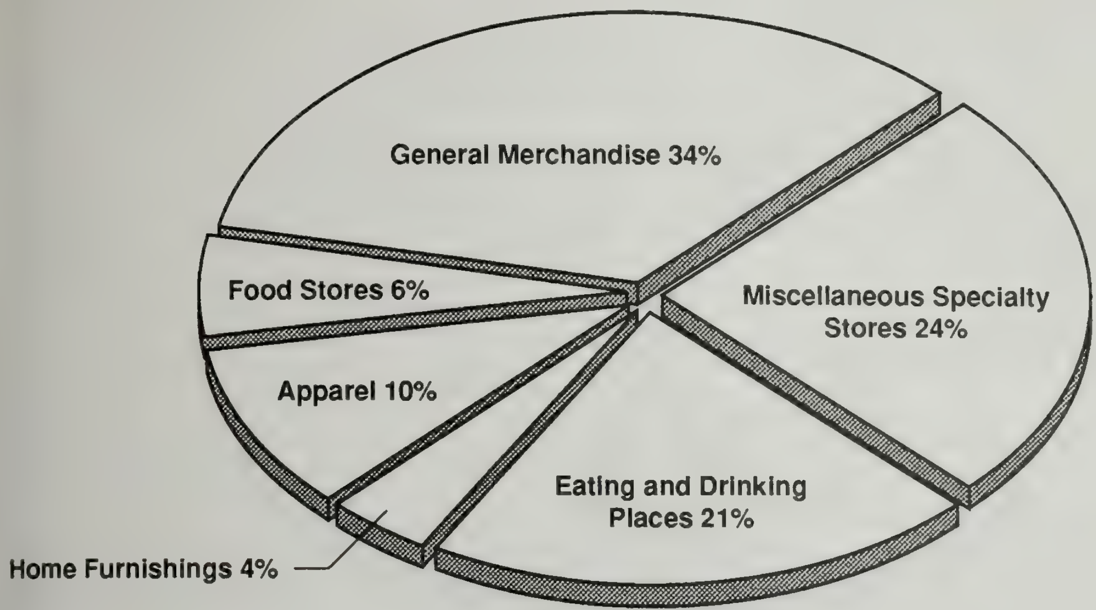
Boston's core retail area, encompassing the Downtown Crossing, Faneuil Hall Market Place, and Back Bay retail districts, represents the largest concentration of retail activity in Massachusetts. Core area retail sales mix and modes of travel used to reach it are shown in Figures 7.7 and 7.8 and Tables 7.5 and 7.6. This area encompasses nearly 3.5 million square feet of net retail space (occupying 5.6 million square feet of gross building area),

Table 7.4

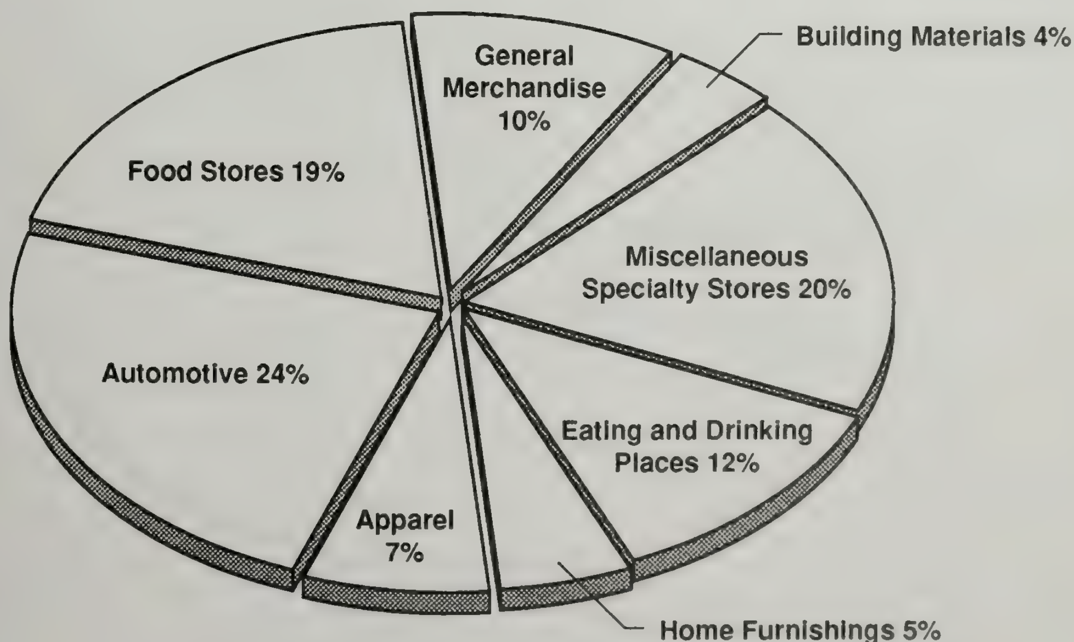
OCCUPANTS OF OFFICES IN DOWNTOWN BOSTON

Occupant Type	Square Feet (Millions)	Percent of Total
Insurance	6.5	18
Financial Services	5.3	15
Law Services	5.2	15
Business Services	3.8	11
Banking	3.7	10
Telecommunications	2.9	8
Architecture and Engineering	2.2	6
Accounting	1.1	3
Computer	0.8	2
Miscellaneous (Government, Medical, Education, etc.)	4.3	12
Unknown	0.7	--
Total	36.8	100

Source: Cambridge Systematics, Inc., building area/land use survey, and Coldwell Banker, Inc.



Central Business District

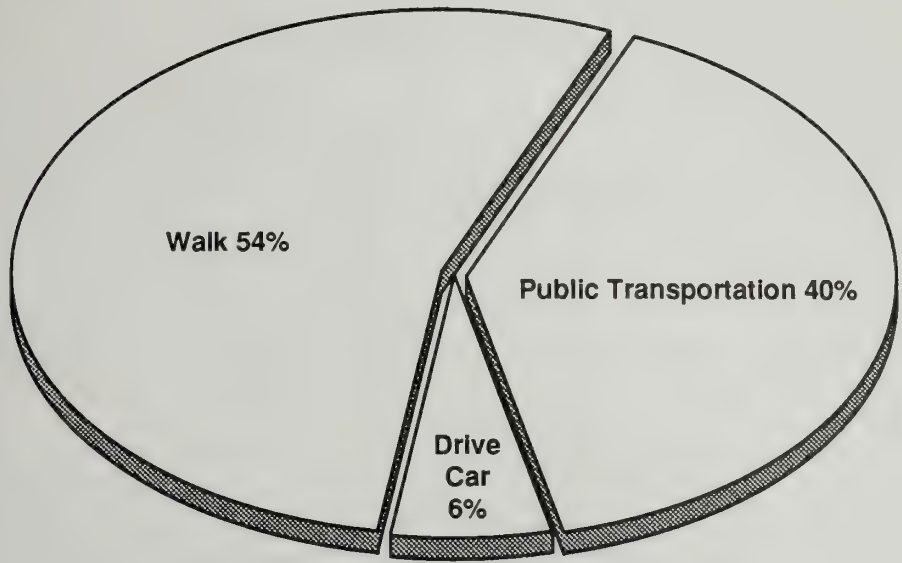


Metropolitan Area

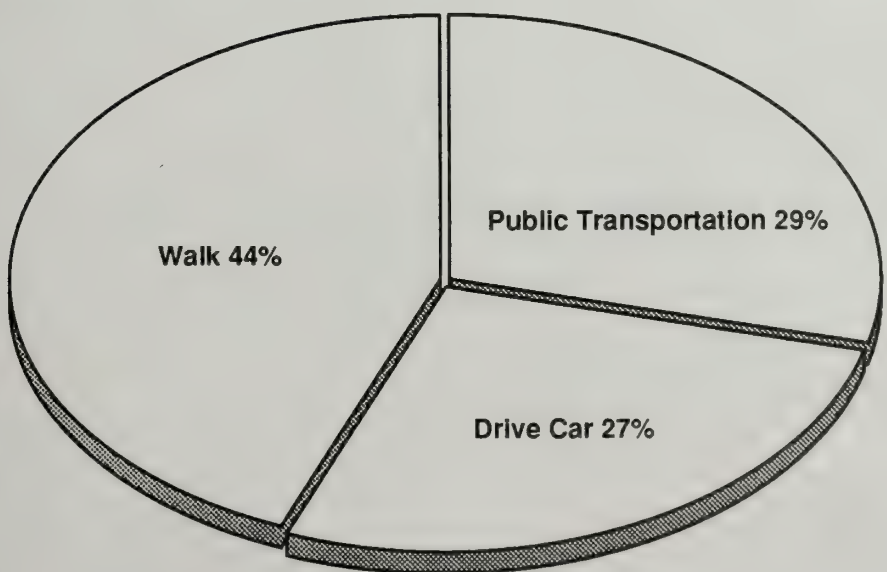
Source: U.S. Census of Retail Trade, 1982.

FIGURE 7.7 **Mix Of Retail Sales**

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R



To Downtown Crossing (A)



To Back Bay (B)

(A) Cambridge Systematics, Inc. Shopper Surveys, 1980.
(B) Includes Copley Place, Newbury Street and Prudential Shopping Center, 1985 Survey.

FIGURE 7.8

Mode Of Access To Shopping Districts

Table 7.5

MIX OF RETAIL SALES

	Percent in Central Business District	Percent in Metropolitan Area
Building Materials	0	4
General Merchandise	34	10
Food Stores	6	19
Automotive	0	24
Apparel	10	7
Home Furnishings	4	5
Eating and Drinking Places	21	12
Miscellaneous Specialty Stores	25	19
Total	100	100

Source: U.S. Census of Retail Trade, 1982

Table 7.6

MODE OF ACCESS TO SHOPPING DISTRICTS

	Percent to Downtown Crossing[1]	Percent to Back Bay[2]
Walk	54	44
Drive Car	6	27
Public Transportation	40	29
Total	100	100

Sources:
1. Cambridge Systematics, Inc., Shopper Surveys, 1980
2. Includes Copley Place, Newbury Street, and Prudential Shopping Center, 1985 Shopper Survey

employing approximately 17,000 retail workers and generating annual sales of nearly $1.2 billion (1986 estimates based on Department of Commerce employment data, Dun & Bradstreet sales data, and land use survey data). The heart of the City's traditional Central Business District (CBD) is Downtown Crossing, which alone accounts for annual retail sales of over $540 million. (Downtown Crossing is included in the Midtown/Retail district in the land use study.) Retail activity within the project area is heavily oriented towards department stores, apparel, restaurants, and specialty shops (see Figure 7.7 and Table 7.5). Roughly half of the shoppers at both the Downtown Crossing and Back Bay areas walk in from nearby office workplaces, while the remainder come by public transportation, and to a lesser extent, by car (see Figure 7.8 and Table 7.6).

Established Retail Districts. The following established retail districts are located in the study area:

- Downtown Crossing: Downtown Crossing retail sales are dominated by the Jordan Marsh and Filene's department stores, which account for a majority of the total retail floor space. There are also concentrations of fashion apparel stores and specialty retailers selling jewelry, furs, cameras, and collectibles. The apparel and general merchandise stores depend largely on midday purchases by nearby office workers, as well as City residents, most of whom come in by foot or by public transit. Tourists also account for less than 5 percent of retail sales in Downtown Crossing.

- Faneuil Hall/Haymarket: Faneuil Hall Market Place derives its retail sales largely from a combination of food and gift sales in the form of lunchtime activity generated by nearby Government Center and Financial District office workers, year-round activity generated by tourist and business visitors to the City, and visits by affluent City and suburban residents. The nearby hotels and tourist sites also support sales to visitors.

- North End: The established business district of the North End primarily consists of retail stores and restaurants. Many of the establishments are small retailers and some wholesalers. Many enjoy good visibility from automobile traffic along heavily travelled Cross Street and have a loyal client base.

- Back Bay: Copley Place and Prudential Center include many high end retail stores serving office workers, hotel and conference visitors, and suburban shoppers. The Newbury Street retail district serves a broad regional market with art galleries, upscale specialty retail, restaurants, and boutiques catering to the entire metropolitan area. Boylston Street retail activity consists primarily of restaurants and apparel establishments serving area residents, office workers, and students.

7.1.1(e) Industrial/Manufacturing Space

The Boston metropolitan area contains approximately 120 million square feet of industrial space. The Artery/Tunnel Project study area contains approximately 40 million gross building square feet of industrial space with over 54,000 employees, largely concentrated in South Boston, East Cambridge, and the South Bay/Newmarket area (see Table 7.2).

In South Boston, the Boston Marine Industrial Park includes a variety of printing and publishing firms, food preparation and processing firms, textile product manufacturers, and steel fabrication firms. Also located there are the Boston Design Center, the General Ship shipyard, and a Subaru automobile import preparation facility. The Gillette Company factory is also located in South Boston. The South Bay/Newmarket industrial zone includes the Boston Herald newspaper plant, the Boston Flower Market, and the Newmarket wholesale meat distribution center. The East Cambridge area is home to computer software and biotechnology firms, as well as research and development space. In addition, the East Boston/Logan Airport area has a concentration of air shipping and transportation firms.

Over 35,000,000 square feet of industrial space was constructed in the NECMA between 1980 and 1988, with the peak of construction in 1985 (see Table 7.7). In 1988, Boston/Cambridge (an area roughly comparable to the project study area) defined by REIS (Real Estate Information Service) reports, comprised almost 9 percent of the new industrial construction (see Figure 7.9).

Vacancy rates for industrial space in the NECMA currently average 19 percent. Vacancy rates in Boston/Cambridge are approximately 21 percent (see Table 7.8).

As Table 7.9 shows, the manufacturing industry in Boston has been declining over the last 10 years. Overall, 11,676 jobs were lost in manufacturing from 1977 to 1985, with a decrease of 300 firms. This decline is part of a regional trend in manufacturing industries and is expected to continue.

7.1.1(f) Residential Space

Between 1980 and 1985, the City of Boston gained 8,109 year-round housing units, increasing from 241,304 to 249,413 units. The study area neighborhoods which gained the most new housing units were Charlestown and the Central Area (see Table 7.10).

As of June 1988, the median price of condominiums in the study area ranged from $105,000 to $166,437. Condominiums in East Boston and South Boston offered the lowest prices in the study area, ranging from $105,000 to $125,000. The area known as Boston Proper, comprised of the Central Area, Back Bay/Beacon Hill, and South End neighborhoods had the highest median price of $166,457. The median 1988 condominium sales price in Charlestown ran about $15,000 below the Boston median price. The Suffolk County median price level, $141,324, was at the middle of the range of the study area neighborhoods.

From 1984 through June 1988, Suffolk County overall had an increase of 57 percent in the median condominium sale price. Within the study area, East Boston had the greatest overall percentage growth in sales prices of 105 percent. South Boston had the lowest percentage growth of 63 percent. On an absolute basis, Boston Proper and Charlestown gained the greatest dollar amount. In 1986, price growth shifted to East Boston and South Boston condominiums, where the median sales price rose almost 60 percent in both neighborhoods in that year.

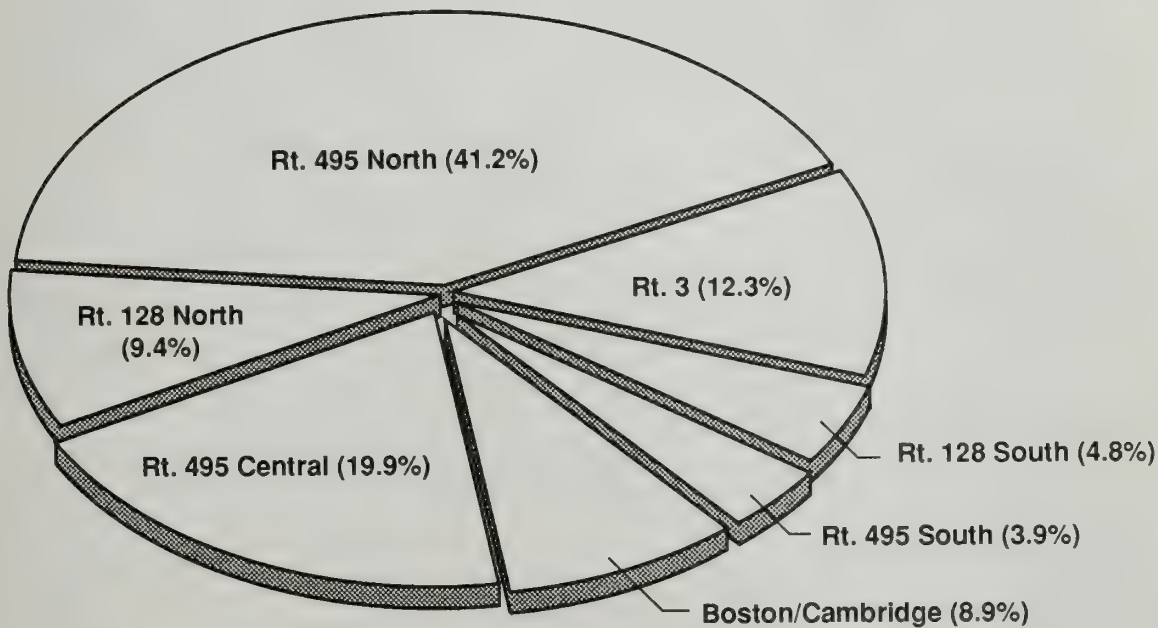
The current slowdown in the housing market began in 1987. Demand began to fall, as Federal tax changes affected real estate investment activity and investor demand declined. South Boston and East Boston experienced almost no price increases in 1987, although the Boston Proper and Charlestown markets were still healthy, with median prices rising 12.5

Table 7.7

ANNUAL CONSTRUCTION OF INDUSTRIAL FACILITIES IN METROPOLITAN BOSTON (NECMA) 1980-1988

Year	**Square Feet**
1980	3,331,000
1981	3,523,000
1982	3,404,000
1983	2,558,000
1984	4,891,000
1985	8,085,000
1986	5,401,000
1987	3,924,000
1988 (estimate)	5,974,000
Total (1980-1987)	35,117,000
Annual Average (1980-1987)	4,389,625

Source: REIS Report, Inc., 1988



Source: REIS Reports Inc., 1988.

FIGURE 7.9

Distribution Of New Industrial Construction In Metropolitan Boston (NECMA) 1988

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

Table 7.8

VACANCY RATES FOR
METROPOLITAN BOSTON INDUSTRIAL SPACE

Submarket	**Percent Vacant**
Route 128 South	28
Route 495 North	26
Route 495 South	22
Boston/Cambridge	21
Route 3	18
Routes 128 North/93	11
Route 495 Central	11
Route 128 West	8
Metro Average	19

Source: REIS Report, Inc., 1988

Table 7.9

MANUFACTURING EMPLOYMENT IN BOSTON 1977-1985

		1977		1985		Absolute Change 1977-1985		Percent Change 1977-1985	
SIC	Industry	Firms	Employment	Firms	Employment	Firms	Employment	Firms	Employmen
20	Food Products	84	7,249	66	3,878	-19	-3,371	-23	-47
22	Textile Products	26	390	19	332	-7	58	-27	-15
23	Apparel	242	8,930	150	5,047	-92	-3,883	-38	-43
24	Lumber/Wood Products	11	471	21	124	10	-347	91	-74
25	Furniture/Fixtures	48	832	35	575	-13	-267	-27	-31
26	Paper/Allied Products	35	1,222	17	723	-18	-499	-51	-41
27	Printing/Publishing	341	11,701	332	11,459	-9	-242	-3	-2
28	Chemicals/Allied Products	32	1,604	26	2,009	-6	405	-19	26
29	Petroleum Products	2	238	1	51	-1	-187	-50	-79
30	Rubber/Plastics	20	347	16	1,025	-4	678	-20	195
31	Leather Products	38	1,629	18	522	-20	-1,107	-53	-58
32	Stone/Glass/Clay	25	453	13	366	-12	-87	-48	-19
33	Primary Metals	18	828	12	891	-6	63	-33	8
34	Fabricated Metals	90	6,974	62	5,515	-28	-1,459	-31	-21
35	Machinery (except Electric)	86	4,383	63	2,766	-23	-1,617	-27	-37
36	Electric/Electronic Equipment	41	2,149	38	2,139	-3	-10	-7	0
37	Transportation Equipment	10	1,066	7	658	-3	-408	-30	-38
38	Instruments	51	1,704	37	2,720	-14	1,016	-27	60
39	Miscellaneous Manufacturing	79	1,450	47	1,254	-32	-196	-41	-14
	Total	1,279	53,620	980	42,045	-299	-11,576	-23	-22

Source: Massachusetts Division of Employment Security; EDIC, Boston; and Cambridge Systematics, Inc.

Table 7.10

YEAR-ROUND RESIDENTIAL UNITS
IN THE STUDY AREA BY NEIGHBORHOOD

Neighborhood[1]	1980	1985	Net Change	Percent Change
East Boston	14,552	14,871	319	2.2
Charlestown	6,121	6,773	652	10.7
South Boston	14,055	14,294	239	1.7
Central Area	11,671	12,576	905	7.8
Back Bay/Beacon Hill	18,192	18,525	333	1.8
South End	13,761	13,902	141	1.0
City of Boston	241,304	249,413	8,109	3.4

1. Neighborhood Planning Districts used by the Boston Redevelopment Authority. They correspond closely to neighborhoods of the study area.

Source: BRA Housing Survey, 1985, U.S. Census 1980

and 20.5 percent, respectively. During 1988, price increases have remained modest or prices have even fallen, as in Charlestown.

Sales volumes have also dropped since 1987 in the established strong condominium markets of Boston Proper and Charlestown, down by 22 percent and 41 percent on an annualized basis, respectively. Volume of sales in East Boston and South Boston have always been lower than other study area neighborhoods because there are fewer condominiums overall in these two areas. Volume has dropped in these two neighborhoods as well. Suffolk County overall has experienced fewer sales transactions.

The 1980 median gross rent for the City was $251; by 1985, that figure had reached $400. The Rental Housing Association of the Greater Boston Real Estate Board prepared a vacancy and rental survey for years between 1981 and 1987, using average rents rather than median rents. The average monthly rent for all units in Boston in October 1986 was $601 (with a renter vacancy rate of 5.7 percent), while in 1987 it rose to $613 for all units in Boston.

Between 1980 and April 1987, the overall housing vacancy rate in Boston dropped from 9.5 to 1.9 percent, according to the Federal Home Loan Bank Board. The vacancy rate decrease is due primarily to the active condominium market, which by 1987 had changed the ownership status of some 25,600 rental units in the City of Boston. Some of these investor-owned units continued to serve the rental market.

In 1988, the Boston City Council restricted the conversion of rental units by requiring a removal permit before a unit could be converted to condominium status. As a result, condominium conversion has become more difficult, and the proportion of rental apartments and condominium units in the housing stock is expected to remain fairly stable if there is no new construction to alter the balance.

7.1.1(g) Tourism And Hotel Space

The visitor (business and tourist) industry is a major industry in Boston and contributes substantially to the economy of the region. There were 7.6 million visitors to the Greater Boston area in 1986 (see Table 7.11). Approximately 50 percent of all visitors use the 22,199 hotel rooms in the Boston area when visiting, and Boston area hotels achieved a 71 percent average occupancy rate. (Over 3,000 of these hotel rooms were added between 1983 and 1987.) This rate is higher than the national average rate of 69 percent occupancy for hotel rooms. Day visitors are also a significant sector of the tourism economy, comprising almost 30 percent of total visitors. The remaining 20 percent are visitors who stay with friends and relatives while in the Boston area.

Three major purposes for visiting Boston have been identified among the visitor population, as shown in Table 7.12. These groups are: (1) the commercial or business segment, which includes individual business travellers; (2) the convention/meeting segment, which includes those attending conventions or meetings in the area; and (3) the tourist segment, which includes those visiting for pleasure purposes. As Table 7.12 shows, approximately 31 percent of visitors are in Boston for business trips, with 11 percent attending conventions or meetings. The majority of visitors, over 50 percent, are tourists and day visitors. About 4 percent of hotel stays are by permanent residents and others.

Visitors to Boston provided a total of $2.27 billion in direct expenditures in 1985. As

Table 7.11

VISITORS TO GREATER BOSTON

Visitor Type	1985 Number of Visitors	1985 Percent of Total	1986[1] Number of Visitors	1986[1] Percent of Total
Using Hotels and Motels	3,610,200	49.6	3,779,800	50.0
Visiting Friends and Relatives	1,550,300	21.3	1,587,500	21.0
Day Visitors	2,118,100	29.1	2,192,300	29.0
Total	7,287,600	100.0	7,559,600	100.0

1. Preliminary estimates

Source: An Economic Impact Study of the Tourism and Convention Industry for the Greater Boston Area, Pannell Kerr Forster and the United States Travel Data Center, May 1987, Update December 1987

Table 7.12

PURPOSE OF VISITS TO GREATER BOSTON (1985)

Primary Purpose For Trip	Hotel/Motel Users	Visiting Friends/ Relatives	Day Visitors	Total	Percent of Total
Tourists	993,700	1,395,300	1,482,700	3,871,700	53.2
Business/Commercial	1,582,000	155,000	550,700	2,287,700	31.4
Conventions/Meetings	733,000	---	84,700	817,700	11.2
Permanent Residents	151,900	---	---	151,900	2.1
Other	149,600	---	---	149,600	2.1
Total	3,610,200	1,550,300	2,118,100	7,278,600	100.0

Source: An Economic Impact Study of the Tourism and Convention Industry for the Greater Boston Area, Pannell Kerr Forster and the United States Travel Data Center, May 1987

shown in Table 7.13, the expenditures made by visitors include lodging, food, entertainment and recreation, retail trade, and transportation. Food expenditures account for the largest share, with over $800 million spent in food service establishments at hotels and elsewhere. Table 7.14 shows the breakdown of expenditures by visitor and lodging type. Business travellers account for the largest portion of tourism expenditures, $872 million in 1985.

The tourism industry employed 46,205 people in 1985, as shown in Table 7.15. The business sectors or industries providing tourism-related employment include lodging, food, transportation, retail trade, and entertainment and recreation. The hotel and food industries employ the majority (36,614) of tourist industry workers.

7.1.1(h) Accessibility

The major physical factors that limit accessibility to the study area have been described in Chapter 3. These factors are congestion at the major points of entry/egress (Charlestown-City Square, Storrow Drive, the Callahan and Sumner Tunnels, the Massachusetts Turnpike, the I-93/I-90 Interchange) and along the downtown Central Artery, as well as the limited parking within the study area. Approximately 38,000 more workers were commuting into the study area in 1987 compared with 1980, an increase of 14 percent. The increase in commuter traffic has been only partially offset by increased capacity of MBTA commuter rail service and the Red and Orange Lines, and the result has been a marked increase in traffic congestion. Congestion has contributed to increasing the cost of doing business in Boston, which was recently (1988) ranked by the Office Network, an affiliation of real estate firms, among the five most expensive cities in Europe and the United States in rents and in operating costs for new office space.

At the same time, the existing level of accessibility continues to provide benefits that attract new businesses to the study area and/or contribute to the expansion of existing businesses. The study area is a focal point for a broad spectrum of trained labor, provides access to a diversity of markets, and has a cultural or prestige value to firms and individuals who choose to locate their business there. Thus, in the period of national growth and prosperity since the FEIS/R, the Boston region and study area have performed above the U.S. average, increasing the region's per capita income and maintaining a higher than average employment level compared to the nation as a whole. Under these favorable conditions, the negative effects of increased congestion on the overall economy have been masked by vigorous growth, even though time lost to travel is a major factor in the daily lives of most of the participants in the economy.

7.1.2 Changes In Economic Activity Since FEIS/R By Subarea

7.1.2(a) Area North Of Causeway Street

This subarea is comprised of North Station, the West End, Charlestown, and the Navy Yard/Constitution Plaza. Population in the subarea grew by approximately 5 percent since 1980 to approximately 18,600 in 1985. Employment in this subarea has fluctuated considerably since 1980 due to rapid expansion of activity in the Navy Yard and contraction along the northern waterfront of Charlestown, where several major industrial plants have closed. Of 29,502 workers in 1986, the largest employment sectors are office (36 percent of total), medical (30 percent), and industry/wholesale (19 percent). Various government offices and Massachusetts General Hospital are major employers in the subarea. The North Station area has been the center of extensive office renovation and conversion of furniture

Table 7.13

DIRECT EXPENDITURES BY VISITORS IN GREATER BOSTON (1985)

Type of Expenditure	Amount Spent ($ millions)
Lodging (Hotel/Motel)	449.4
Lodging Food Service	220.2
Food Service (Not at Hotels)	606.7
Entertainment and Recreation	163.8
General Retail Trade	184.8
Auto Transportation	206.7
Commercial Transportation	435.3
Total	2,266.9

Source: An Economic Impact Study of the Tourism and Convention Industry for the Greater Boston Area, Pannell Kerr Forster and the United States Travel Data Center, May 1987

Table 7.14

DIRECT EXPENDITURES IN THE BOSTON AREA BY LODGING TYPE (1985) (millions of 1985 dollars)

	Hotel/Motel	Visiting Friends and Relatives	Day Visitors	Total
Tourists	356.4	315.0	95.2	766.8
Business/Commercial	801.9	35.0	35.4	872.3
Conventions/Meetings	463.3	0	5.4	468.7
Permanents	106.9	0	0	106.9
Other	53.5	0	0	53.5
Total	1,782.0	350.0	136.0	2,270.0

Source: Cambridge Systematics calculations based on data provided by Pannel Kerr Foster, U.S. Travel Data Center, 1987

Table 7.15

TOURISM-RELATED EMPLOYMENT IN THE BOSTON AREA (1985)

Business Sector	Number of Jobs
Lodging	10,231
Food Service	26,383
Commercial Transportation	3,602
Entertainment and Recreation	3,072
Auto Transportation	1,216
General Retail Trade	1,701
Total	46,205

Source: An Economic Impact Study of the Tourism and Convention Industry for the Greater Boston Area, Pannell Kerr Forster and the United States Travel Data Center, May 1987

manufacturing to office space, and also provides extensive parking on vacant land. The area will soon be transformed by major redevelopment of the Boston Garden and relocation of the MBTA Green Line subway.

7.1.2(b) Central Area

The Central Area includes Government Center, the Midtown/Retail District, Chinatown/Bay Village, the Financial District, South Station, the Waterfront, and the North End (see Figure 7.4). (Details regarding categories of land use and employment for these districts of the Central Area are shown in Table 7.16 and Figures 7.10 and 7.11.)

Central Area residential population grew from 17,000 in 1980 to 18,000 in 1985 due to City of Boston policies encouraging downtown residential development. Employment is estimated to have grown by over 10 percent during the same period, having reached 189,700 in 1986. Most of the employment growth has been concentrated in the Financial District, which represents nearly half (48 percent) of the total 1986 employment in the Central Area. The Midtown/Retail District (17 percent of total) and Government Center (12 percent) are the two next largest employment areas within the Central District. Since the writing of the FEIS/R in 1982/83, there has been a rapid expansion of new office space, particularly in the Financial District, where well over 1 million square feet were added each year.

The majority (78 percent) of Central Area employment is made up of office workers, with 10 percent of the total in retail employment and only about 4.5 percent in industrial/wholesale activities, primarily in the Leather District and Chinatown. The Midtown/Retail District is the focus of the City's retail activity and provides over 20 percent of the study area's total retail employment.

7.1.2(c) I-93/I-90 Interchange And Massachusetts Avenue Interchange Area

This subarea includes the South End, South Bay, and Newmarket areas of Boston. Population of the subarea is estimated to have reached 27,880 in 1985, which means that the number of inhabitants has remained essentially stable since 1980 (1 percent growth in 5 years). The housing supply in this subarea is expected to remain essentially unchanged, which could lead to a slightly declining population as the average family size continues to decrease.

Employment in the subarea is estimated at 28,900 in 1986. The largest numbers of these employees are in the industrial-wholesale sector (31 percent) and the medical sector (28 percent). The removal of the old elevated MBTA Orange Line and revitalization along Washington Street is producing substantial changes in the character of this residential area. Major employers in the subarea are the two major hospitals, Boston City Hospital and University Hospital. Employment in this subarea has not grown substantially since the FEIS/R.

7.1.2(d) South Boston And South Boston Bypass Road Area

The South Boston residential subarea had a 1980 population of approximately 30,600, which remained essentially constant through 1985. Employment in 1980 was estimated at 8,200 and grew to 10,767 in 1986. Approximately 34 percent of the jobs are industry or warehousing/wholesale activities.

The industrial area of South Boston (northern waterfront area) has a very small resident population near Fort Point Channel, estimated from the available residential space at a few hundred. However, employment in this subarea has increased dramatically since 1980, when it

Table 7.16

CENTRAL AREA LAND USE AND EMPLOYMENT (1986)

Gross Building Square Feet By Land Use Type

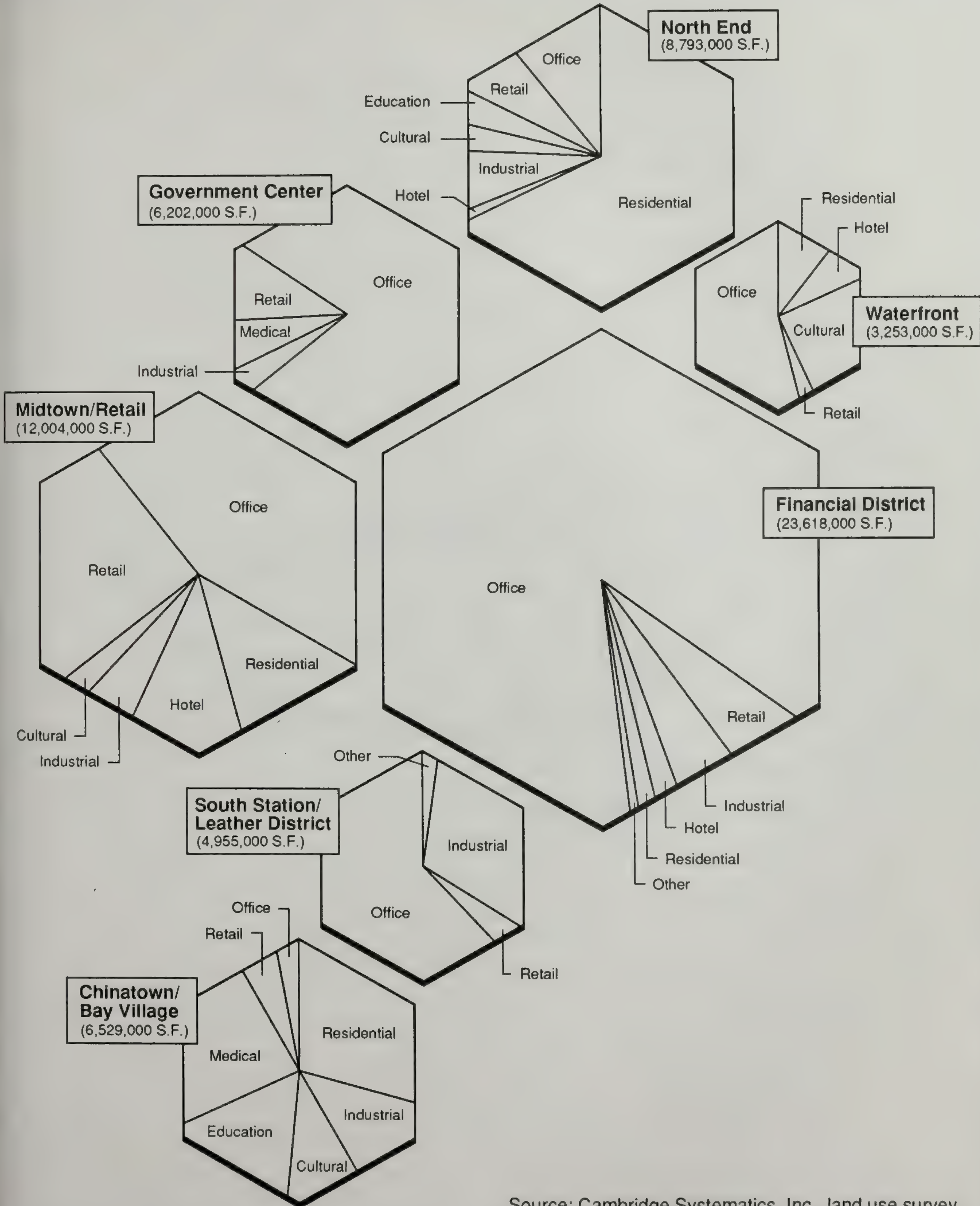
District	Office	Retail	Medical	Education	Culture	Industrial	Hotel	Transport	Residential
Government Center	4,961,500	630,067	315,539	1,600	30,000	173,396	84,150	0	5,729
North End	965,725	588,453	3,417	315,469	255,593	587,806	96,320	6,300	5,943,897
Waterfront	1,765,278	96,662	0	0	778,000	20,404	228,000	16,800	348,287
Financial	20,508,500	1,204,451	51,630	5,850	26,545	1,090,754	400,661	18,129	311,036
Midtown/Retail	5,303,465	3,017,986	9,000	33,000	302,667	608,564	1,331,000	0	1,398,760
Chinatown/Bay Village	193,182	336,688	1,552,007	1,082,289	632,652	816,309	192,500	0	1,722,974
South Station/ Leather	3,075,280	203,884	0	0	0	1,567,310	0	50,000	58,937
Total	36,772,930	6,078,191	1,931,593	1,438,208	2,055,457	4,864,543	2,332,631	91,229	9,789,622

Employment

District	Office	Retail	Medical	Education	Culture	Industrial	Hotel	Transport	Residential
Government Center	20,236	1,797	1,136	3	41	250	107	0	23,570
North End	4,259	1,695	12	568	386	846	123	6	7,895
Waterfront	6,498	257	0	0	1,050	29	291	17	8,142
Financial	86,481	3,377	186	11	36	1,571	511	18	92,189
Midtown/Retail	21,341	8,364	32	59	409	876	1,697	0	32,779
Chinatown/Bay Village	759	849	5,587	1,948	854	1,175	245	0	11,418
South Station/Leather	10,933	502	0	0	0	2,257	0	50	13,742
Total	150,507	16,841	6,953	2,589	2,776	7,004	2,974	91	189,735

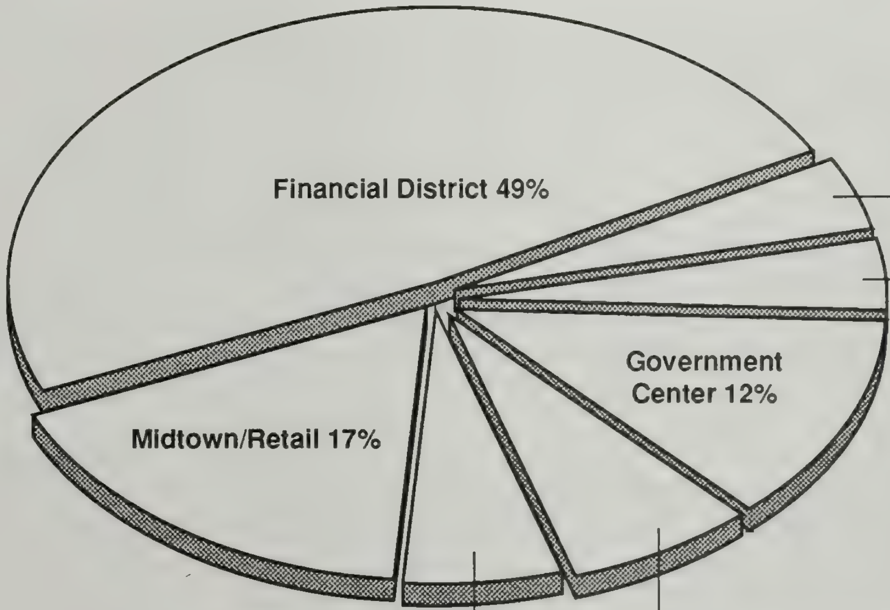
1. See Figure 7.4 for location of districts

Source: Cambridge Systematics, Inc., land use survey carried out for the Artery/Tunnel Project, 1988



Source: Cambridge Systematics, Inc., land use survey for the Artery/Tunnel I-93/I-90 Project, 1988.

FIGURE 7.10	Central Area Building Area, 1987	THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT SUPPLEMENTAL EIS/R



Source: Cambridge Systematics, Inc., land use survey for the Artery/Tunnel I-93/I-90 Project, 1988.

FIGURE 7.11 **Distribution Of Central Area Employment, 1987**

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

was estimated at 16,600, to approximately 30,300 in 1986. Approximately 56 percent of the employment in this subarea is in industrial jobs and 37 percent is in office jobs. Major industrial employers are the Gillette Company plant, printing and publishing at the Boston Harbor Industrial Park, and trucking/transportation, food products and apparel/accessories sectors. The City of Boston's Economic Development and Industrial Corporation (EDIC) has developed the Boston Marine Industrial Park (BMIP) to provide over 3,500 light industrial jobs in recent years. The Boston Design Center (at the BMIP), the World Trade Center at Commonwealth Pier, and Museum Wharf provide active exhibit space to attract visitors to the area. The area also provides over 13,000 parking spaces for commuters on currently vacant land.

There has been substantial development of renovated office space in the area just east of Fort Point Channel since the FEIS/R, but recent uncertainty about the eventual development of Fan Pier and Pier Four slowed office development in 1988. This has resulted in an office vacancy rate of 25 percent, the highest in the City.

7.1.2(e) East Boston/Logan Airport Area

This subarea includes the Eagle Hill, Orient Heights, Paris Flats, Jeffries Point, and Maverick areas of East Boston plus Logan Airport and the Bird Island Flats area. Population increased slightly from 33,000 in 1980 to 33,700 in 1985. Employment grew from 23,600 jobs in 1980 to approximately 25,300 jobs in the subarea in 1986. Over 60 percent of total employment was at Logan Airport.

7.1.2(f) Other Areas

Beacon Hill, the Back Bay, and Prudential/Copley neighborhoods of Boston grew slightly in total population from 29,700 to 31,600 from 1980 to 1985. Employment grew by approximately 8 percent from 76,000 in 1980 to 82,400 in 1987, estimated from the land use study. Insurance, government, and numerous small service industries dominate employment in these neighborhoods. The largest of many local developments since the FEIS/R has been the opening of Copley Place, a 3.4 million-square-foot mixed use complex with major office, hotel, and retail components.

The East Cambridge/eastern Somerville subarea is bounded by Washington Street on the north and Prospect Street to the west. It includes substantial industrial areas as well as the Massachusetts Institute of Technology. Population in this subarea has remained relatively constant at approximately 28,000 inhabitants since 1980. However, this area has been a source of vigorous employment growth as a result of the redevelopment of Kendall Square and the establishment of a number of high-technology firms. The land use survey indicates that 1986 employment reached approximately 58,300, of which 58 percent was office employment. A substantial part of this growth has resulted from firms expanding from the Central Area of Boston.

7.2 ENVIRONMENTAL CONSEQUENCES

Section 7.2 analyzes the long-term economic impacts associated with completion of the Artery/Tunnel Project. Economic impacts associated with the construction phase are described in Chapter 20. The geographic areas referred to in this section are defined in Section 7.1.

The overall economic impacts of the new Artery/Tunnel facilities, in comparison to the conditions without the project, hereinafter referred to as the 2010 baseline, will be beneficial for the State, the metropolitan area (NECMA), Suffolk County, and the study area. The impacts are summarized in Table 7.17 (see text for definition of terms). Improvements in accessibility to downtown Boston and in broader areawide traffic flow will allow continued economic growth of the downtown, the City, and the region, which will entail significant benefits compared with the congestion-limited growth represented by the 2010 baseline.

In the baseline condition, traffic capacity and accessibility limitations of the existing highway system would increasingly constrain employment growth beyond the year 1999. Greater travel time costs for trucking and deliveries, higher wages to attract and compensate commuters, and lost time for visitors would all lead to slower growth in downtown office occupancy, and the industrial, retail, and tourism sectors. While some activities would be able to relocate in the suburbs, much of the future economic growth would not occur at all in the Boston metropolitan area without completion of the Artery/Tunnel Project. The major benefit of the Artery/Tunnel Project will be the avoidance of such congestion-induced losses.

With construction of the Proposed Action, employment in the NECMA will continue its long-term growth in response to established economic trends without constraint by traffic congestion. For the NECMA, this represents an addition of approximately 18,000 jobs, $723 million per year of disposable personal income, and $1.8 billion of annual sales (expressed as 1987 dollars) in the year 2010, as compared to the 2010 baseline conditions. Within the study area, decreased congestion resulting from the Proposed Action will allow the addition of 20,000 jobs, add $2 billion to total business sales, and allow tourism to reach a level that will add $169 million per year to overall tourist spending.

7.2.1 Metropolitan Economic Forecasts

This section describes various growth forecasts for the metropolitan area (NECMA) and the study area that form the background for the economic modeling and impact analyses for the year 2010. The various sources that provided data for the impact analyses and the regional economic model are also described. The basic economic forecasts described here implicitly assume that the level of service for vehicular movement to and through central Boston for the year 2010 is maintained at levels no worse than current conditions. For purposes of the impact analysis, these forecasts are considered achievable with completion of the proposed project, while lesser economic growth is expressed without the proposed project (i.e., 2010 baseline conditions).

7.2.1(a) Population And Employment Forecasts

Total population of the New England County Metropolitan Area was estimated at 3.70 million in 1987, and is forecast to grow to 4.3 million by 2010, a total increase of 15 percent in 23 years. If current City of Boston policies regarding housing development continue to be successful, this growth will occur partly within the City and predominately in the distant suburbs, while the ring of inner suburbs that make up the MAPC region remains at a relatively stable population of around 2.9 million.

Table 7.17

SUMMARY OF LONG-TERM ECONOMIC IMPACTS (YEAR 2010)
(Valued In 1987 Dollars)
(See Text For Details)

Type of Impact	Study Area	Suffolk County	NECMA	Commonwealth of Massachusetts
Total Jobs	20,700 jobs	20,700 jobs	17,800 jobs	(A)
Total Household Income	(C)	$841 billion	$723 million	(A)
Total Business Sales (D)	$2,040 billion	$2,040 billion	$1,754 billion	(A)
Net Revenue	(B)	(B)	(B)	$17 million
Total Value of Reduced Travel Delay	$530 million	(C)	(C)	(C)

(A) State impact assumed to be approximately the same as the NECMA impact
(B) Not Applicable
(C) Not Available
(D) Tourism spending generated by tourists is included in total business sales

Source: Cambridge Systematics, Inc.

As a baseline for regional modeling in this study, employment in the NECMA is forecast to grow from approximately 2.1 million in 1986 to nearly 3.0 million in 2010, an increase of approximately 20 percent. Suffolk County employment is forecast to grow from 642,000 to 774,000 over this same period (see Table 7.18). The forecast employment growth is dependent upon growth of sufficient population to supply the necessary labor force. These are nevertheless conservative forecasts, as they are less than the year 2010 employment projections of 3.2 million for the NECMA and 794,000 for Suffolk County, which have been issued by the BRA. The NECMA metropolitan area growth forecast used here is only slightly greater than the 19 percent growth in employment over the same period forecast by the MAPC for its smaller regions.

A conservative estimate is appropriate because the long-term benefits of the Artery/Tunnel Project depend on estimates of the future economic growth that can occur if the highway system function is maintained in central Boston. Thus, more conservative economic growth forecasts will lead to more conservative estimates of project impacts, which is deemed to be a precedent and appropriate perspective for this study.

Study Area Forecast Methodology. A detailed building area forecast (referred to in this study as the land use survey) was developed for the study area based on the survey described in Section 7.1. A catalog of all known development projects was reviewed with local area experts of the BRA and the Cambridge Community Development Department in order to estimate the likelihood that each project would be completed and to determine the most likely final project sizes and completion dates. Additional potential development sites were identified (referred to as "build-out" capacity), and the overall capacity for development of each subarea was evaluated in meetings with the BRA and other planning experts. Finally, probabilities of completion by 1995 and 2010 were assigned to the various projects as a function of their status (underway, in review, in planning, proposed, build-out). These probabilities and the square footage of the individual projects were used to estimate future development for the years 1995 and 2010. Conversions were taken into account as redistributions among the categories of land use, resulting, for example, in an increase in office space and a decrease in industrial space after an industrial-to-office conversion.

This forecast represents a consensus of the expectations of the development community in the study area and is subject to change if there are significant future changes in economic conditions. A lower rate of regional economic growth would result in delays and cancellations of some projects, possibly shifting some growth forecast by 1995 to the later period and delaying the achievement of levels forecast for 2010 by a few years. However, eventual land use can be expected to resemble the forecast pattern of use as a result of the established zoning and community review procedures that constrain new development. Thus, uncertainties about future economic growth are likely to influence the timing of development, but the land use forecast should remain a valid tool for predicting the nature of growth in the study area. Most of the existing development plans have already taken into account the probable construction of the Artery/Tunnel Project; as a result, the land use forecast, based as it is on existing plans and projects, does not include hypothetical projections of a "no-build" or baseline case, although the disappearance of the Artery/Tunnel Project would change numerous development plans in the study area.

The forecast does not include possible development of air rights or recovered land from the

Table 7.18

SUFFOLK COUNTY AND METRO AREA EMPLOYMENT GROWTH FORECASTS

Area and Industry Category	1986 (Actual)[A]	2010 (Forecast)[B]	2010 (Conservative Estimate)[C]
Suffolk County			
Manufacturing	42,135	35,580	25,925
Construction	15,781	18,264	15,422
Wholesale	28,527	26,484	16,987
Retail	71,066	74,984	78,420
Finance, Insurance, Real Estate	90,860	106,806	134,213
Transport Utilities	37,385	37,695	37,171
Government	103,436	120,927	112,585
Services	251,047	369,562	352,578
Other	1,355	1,580	213
Total[1]	641,592	794,234	773,514
New England County Metro Area			
Manufacturing	400,887	367,368	398,602
Construction	82,854	153,012	115,153
Wholesale	118,027	175,720	211,333
Retail	363,541	475,723	459,404
Finance, Insurance, Real Estate	161,070	282,602	244,827
Transport Utilities	92,453	107,445	97,342
Government	293,006	344,897	332,888
Services	665,291	1,304,764	1,080,502
Other	10,823	23,290	19,270
Total[1]	2,190,597	3,234,822	2,959,321

1. May not sum due to rounding of figures

Source: (A) U.S. Bureau of Economic Analysis, 1988 computer files
(B) Boston Redevelopment Authority, REMI model
(C) Cambridge Systematics, Inc., REMI model

Artery/Tunnel Project, which will increase total 2010 land use in some subareas by a small percentage.

The rate of building area growth implied by the land use forecast is close to established long-term trends over the past 19 years (1970 to 1988) both for new office space (historically about 1.5 million square feet per year) and for employment (historically about 1.1 percent per year, compound) in the City of Boston. Significantly higher growth over a long period is unlikely due to natural limits on the supply of labor and land in the study area. The MAPC forecasts a lower growth rate for the study area (0.9 percent per year, compounded) based on longer-term 38-year trends (1950-1988), although it does include the growth of areas such as industrial South Boston, Logan Airport, and Charlestown Navy Yard, all of which are highly dependent upon improvement of the urban highway system. It should be noted that the study area employment levels for 2010 derived from the land use forecast differ by only 5 percent from those projected by the MAPC, a very small margin over the 20-year planning horizon.

The forecast of growth in total building space in the study area over the 25-year period from 1986 to 2010 averages about 2.8 million new square feet per year, of which approximately 1.6 million square feet would be office space. While significant fluctuations in building development are expected to occur from year-to-year due to regional and national cycles, the long-term average rates are expected to prevail. Thus the forecast assumes a continuation of historic long-term building trends into the future. Total estimated growth in building space over the entire period from 1986 to 2010 amounts to 28 percent.

Employment growth implied by this forecast will be more pronounced than growth in overall square footage of building space because development of new office space is the primary sector of growth. (Office space is forecast to grow by 57 percent, whereas residential space is expected to grow by 18 percent.) Overall growth in employment, as implied by the building area forecast, is expected to be approximately 30 percent from 1986 to 2010, or a total of about 138,000 new jobs (averaging about 6,000 per year) in the study area. Growth in employment from 1986 to 1995 is estimated at 16.5 percent or 85,000 jobs (over 9,000 per year).

New employment in the study area will be predominately office-based employment, with over 110,000 of the 138,000 new jobs expected to be in that category. Other growth in the study area will be primarily in sectors that support the growth of office-based employment. Transportation employment, primarily at Logan Airport, is projected to provide about 10,000 new jobs, retail employment about 9,000 new jobs, and hotel employment about 5,000 new jobs. Table 7.19 summarizes the overall study area land use and employment growth forecast. Table 7.20 lists a more detailed geographic breakdown of employment for the Central Area.

7.2.1(b) Methodology Of Impact Analysis

The economic impacts discussed in the following subsections represent the difference between 2010 conditions with the Proposed Action and 2010 baseline conditions. These differences will occur as a result of two types of impacts resulting from the transportation changes. First, the study area will become more or less attractive to business by changing the real costs of doing business, or changing the advantages of particular site locations. Second, the study area will become more or less attractive to people as a place to work,

Table 7.19

STUDY AREA LAND USE AND EMPLOYMENT FORECAST

	Total Gross Square Feet of building space		Employment	
Land-Use	**1986**	**2010**	**1986**	**2010**
Office	70,316,299	110,417,640	282,200	392,700
Retail	14,544,986	17,750,857	39,100	48,200
Medical	7,086,257	9,640,057	25,500	30,400
Educational	13,910,485	14,122,460	20,300	20,700
Cultural/Recreational	6,652,569	8,105,570	8,900	10,900
Industrial	40,393,140	43,285,466	54,400	51,000
Hotel	6,241,433	9,548,083	8,000	13,000
Residential	92,910,082	109,221,961	N/A	N/A
Transportation	1,674,203	1,729,487	16,700	26,400
Total	253,729,754	323,821,581	455,100	593,000

N/A: Not applicable

Source: Cambridge Systematics, Inc.

Table 7.20

LONG-TERM RETAIL SALES IMPACTS DUE TO THE ARTERY/TUNNEL PROJECT

			2010 Retail Sales (1987 Dollars, millions)		
		1986	**Baseline**	**Proposed Action**	**Gain (Loss)**
Shopper Categories in Study Area:	Mode of Travel:				
o Visiting Shoppers	Car (13%)	340	400	420	20
	Transit (24%)	620	780	780	0
o Downtown Worker/ Shoppers	Walk (33%)	860	1,060	1,080	20
o Area Residents	Walk (20%)	520	650	650	0
o Tourists	(10%)	260	320	330	10
Total Direct Impact on Study Area		2,600	3,210	3,260	50
Total Direct, Indirect, and Induced Impacts:					
o on Suffolk County		3,600	4,500	4,610	110
o on rest of Metro		10,000	16,625	16,600	(25)
o on Total NECMA		13,600	21,125	21,200	85

Source: Cambridge Systematics, Inc. and REMI Model

shop, visit, or live, by changing the travel time and the ease or difficulty of travelling to or within the area.

These transportation changes will generate economic impacts by causing changes in business sales, business locations, and/or housing demand. These effects will lead to changes in jobs and personal income for individuals, property values, building rents, vacancies, and real estate development activity. These are the "direct" impacts, directly attributable to the Artery/Tunnel Project.

The direct impacts lead to further "spin-off" domino effects on the local economy, which are referred to as "indirect and induced" impacts. "Indirect" impacts occur as other businesses supplying equipment, goods, and services to the downtown businesses expand or contract as a consequence. "Induced" impacts occur as changes in employment and worker income lead to changes in personal spending, causing local and personal services firms to expand or contract as a consequence.

To evaluate the direct effects of the Artery/Tunnel Project, a series of techniques and sources were used. These include:

- o Evaluation of downtown and suburban office markets, tenant mix, and absorption projections

- o New surveys of downtown office workers and downtown shoppers (concerning spending and travel patterns)

- o Analysis of Dun & Bradstreet time series tracking of downtown business growth and turnover patterns

- o Evaluation of residential property prices and transfers

- o Previous market studies of area office, retail, tourism, and convention activity

- o Interviews and discussions with developers, brokers, property owners and managers, merchants, shippers, and other affected businesses, including neighborhood business representatives in each part of the study area

- o Business inventory, market assessment and interviews with commercial and industrial businesses

- o Case studies of experiences on downtown construction projects elsewhere

To estimate the total impact of the Artery/Tunnel Project (including indirect and induced impacts), an economic simulation model developed by Regional Economic Models, Inc. (REMI), was used. The REMI model was run to estimate the effects of the Proposed Action on Suffolk County and on the entire five-county NECMA. The same computer simulation model has been used by the BRA for its long-term forecasting and similar models have been used by state and regional agencies in over 20 states.

The REMI model is a policy analysis tool designed to evaluate how the region's economic

growth or decline is affected by policies and actions that affect relative business costs and productivity. These include the effects of changes in transportation costs, tourism, office development, retail patterns, wage rates, and occupational training. The model estimates impacts on employment, business sales, and personal income, as well as impacts on occupational demand and wage rates. The REMI model used for this analysis was calibrated based on historical data on business employment and output for the Boston metropolitan area from 1967 to 1987, together with detailed input-output accounting of inter-industry relationships (from the Regional Service Research Institute) and national forecasts of growth by industry (from Data Resources Inc.).

7.2.2 Office Impacts

The Artery/Tunnel Project will support continued growth of the downtown office-based economy by improving employee and business visitor access to downtown and the airport, by reducing travel times, and by allowing more vehicles to pass through. Congestion associated with the 2010 baseline would limit the number of vehicles that can pass through and would not allow continued development of the office-based economy at the rate projected for the 1999 to 2010 period. It would also increase travel time and travel cost for truck deliveries of supplies and products, for employees, and for business visitors and clients. These factors raise costs of doing business and constrain business growth.

There are additional impacts as well. If there is any measurable exodus of businesses leaving the City due solely to the construction of the Artery/Tunnel Project, the reverse may also be true: those types of businesses that leave in the short term solely because of project construction are also likely to return to the City after project completion.

In the long term, all business and industry within the metropolitan area will benefit from the Proposed Action due to improved access to Logan Airport and the City. Those suburbs closest to Boston, including Quincy, Malden, Medford, Cambridge, Somerville, and Revere are most likely to benefit, particularly through demand for new space for industries dependent on easy access to Logan Airport and for service industries that require easy access to downtown businesses.

Overall, the 2010 baseline would result in a forecast of 6,600 fewer office jobs in the City of Boston, and 10,000 fewer total jobs in the City of Boston and the metropolitan area. However, there are also a variety of retail, tourism and other business impacts that together will cause the overall difference in the total number of jobs to be substantially different. The Proposed Action will result in benefits in terms of business expansion and a relative increase in property values for downtown office real estate. The greatest long-term potential benefits will accrue to those areas where existing traffic conditions or access (preconstruction) may have stalled the full development potential of the area.

7.2.2(a) Office Profile

In order to evaluate office impacts, it is necessary to understand the unique characteristics of the office market within the study area, which is predominantly downtown Boston. The study area includes half of all first-class leasable office space within the metropolitan area. The majority of the downtown office space is occupied by law, banking, finance, and real estate firms. This composition is in marked contrast to suburban office space, which is dominated by the offices of computer firms, defense contractors, and

other manufacturers, as well as the offices of retailers, wholesalers, business services, and professional services (see Figure 7.12).

In effect, there is relatively little competition between downtown and the suburbs for the majority of the tenant pool, which is fundamentally different between the markets. There has already been a significant locational sorting out of their two very different types of businesses. Most companies that value lower rental rates, plentiful free parking, large horizontal floor space, and access to a labor submarket with a lower wage have already located in the suburbs. Most of the downtown banking, finance, and insurance firms have already relocated their "back office" clerical functions at suburban office buildings. Discussion with real estate brokers and tenants confirms that the majority of the office moves have already occurred, and that the types of firms remaining downtown will stay for the long term.

Those firms that remain in the study area office market represent a specialization of firms in the finance, banking, and law businesses that perceive a need to be downtown, due to unique access to airport, hotel, and convention facilities, restaurant/cultural amenities, or, most importantly, the area's agglomeration of similar firms.

The REMI model forecasts for 1987 to 2010 indicate that more than 70 percent of all employment growth in the metropolitan area will be in the areas of finance, insurance, and real estate (FIRE) and services. These are the businesses that fuel the demand for office space within the study area, and good access into downtown will be necessary to allow these types of businesses to continue to grow and attract workers. For many of these firms, constraints on employee and visitor access under the 2010 baseline conditions would limit their growth relative to competition in other financial center cities, rather than causing shifts to the suburbs within the region.

7.2.2(b) Projected Office Space

The land use projections for the study area discussed in Section 7.2.1, considered in terms of occupied office space, indicate the addition of 36 million square feet between 1986 and 2010, including at least 12 million square feet between 2000 and 2010.

The area that will receive the greatest direct benefit from the Artery/Tunnel facilities, due to improved accessibility, will be the South Boston/Fort Point Channel area. Many of the development projects currently being considered or proposed for this area are contingent upon the successful completion of the Artery/Tunnel Project, as well as other unassociated transportation improvements, including replacement of the Northern Avenue bridge and construction of new transit system access. Although this area is currently a peripheral location with difficult access, its long-term role as a location for new office development will alter dramatically once there is a new permanent connection to downtown, the airport, and the regional highway network.

The North Station area is also expected to experience substantial new office development after completion of both the Artery/Tunnel Project and the new Boston Garden mixed use complex. Without the Artery/Tunnel Project, constraints on access to the area, particularly from the south, would limit office development there.

The projected long-term increase in values of downtown property is likely to translate into

higher rental rates that some marginal businesses and industries may not be able to afford, potentially forcing some businesses out of the City or out of business entirely.

7.2.2(c) Types Of Impacts On Office Demand

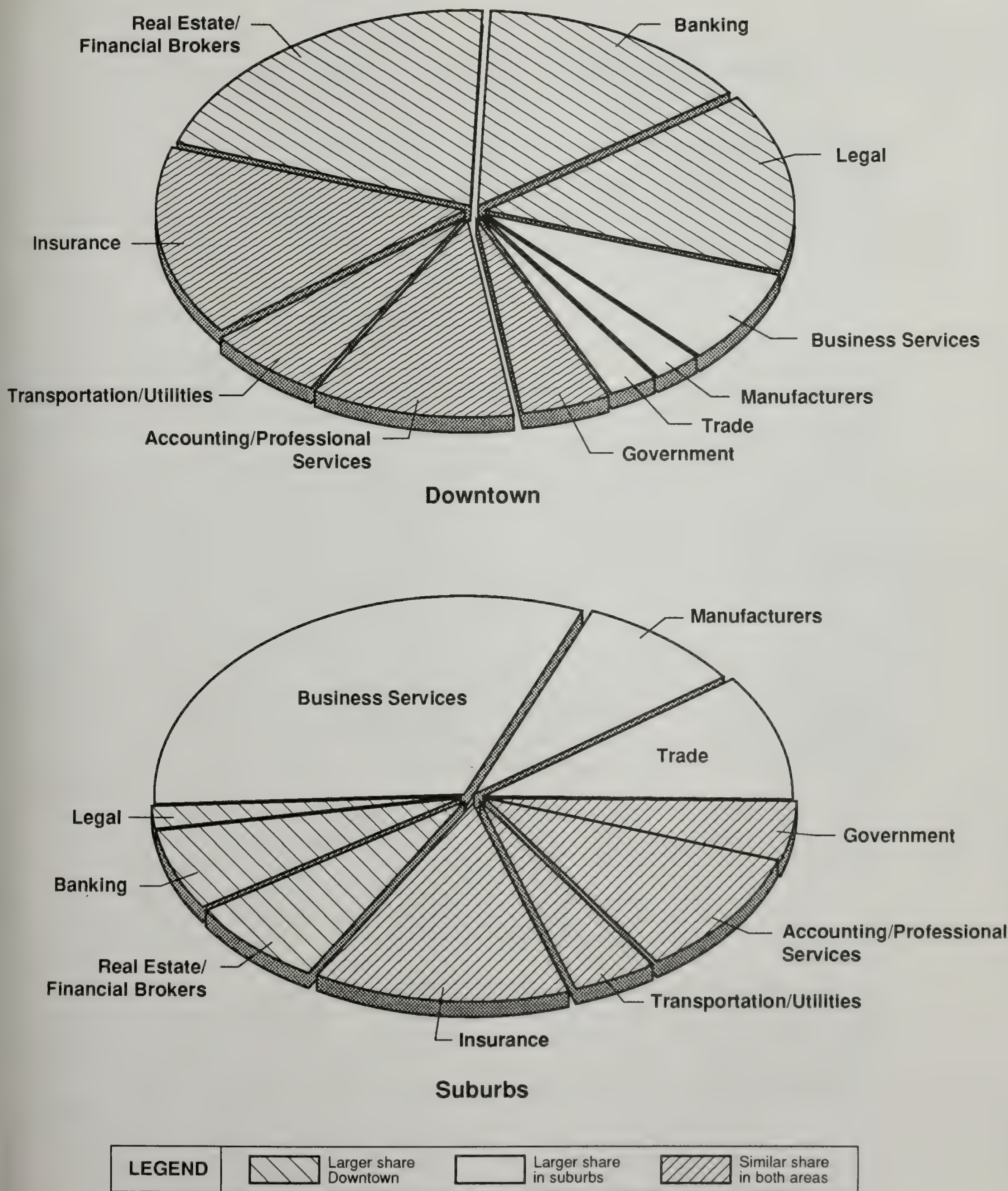
Demand for future office development is affected as a consequence of the time delay for commuters and truckers, and ultimately a real capacity constraint on workers commuting to downtown jobs.

Without construction of the Artery/Tunnel Project, the existing highway facilities would present a constraint on the number of cars that could enter or pass through downtown Boston in any given hour. This constraint would become particularly severe by the year 1999 and would substantially slow further growth of peak period automobile commuting by the 24 percent of downtown office employees who travel by car. While some of these commuters would adjust through staggered work hours or changing their mode of travel, many would not. Based on interviews with businesses and studies of business location factors and consumer markets, the estimated impact would be a reduction in the growth of downtown office employment between 1999 and 2010 by approximately 20 percent. Downtown office employment in the year 2010 would then be 2 percent less than what would result from established trends. (This scenario includes the assumption that public transportation capacity improvements would continue to be made through the year 2010 to keep up ridership levels in proportion to the growing demand.)

Over and above the capacity constraint on auto commuters to downtown is the additional time delay for commuters. The difference in areawide average peak period travel time for trips to/from downtown Boston is estimated to be 19 minutes (two-way total) between the Proposed Action and the 2010 baseline condition, affecting the 24 percent of study area employees who commute by car. (Issues concerning the valuation of time delay are discussed in Section 7.2.9.) The time value of this additional delay, which will be avoided by completion of the Artery/Tunnel Project, is estimated to be approximately $2.50 per auto-commuting worker per day. New surveys at downtown office buildings (Cambridge Systematics, 1989) indicate that an average of 24 percent of downtown workers commute by car. Only those particular office employees are sensitive to changes in automobile access. In a competitive metropolitan labor market, the value of this additional time delay for a portion of the downtown workplace ultimately is reflected in the need for downtown employers to offer correspondingly higher wages.

The third class of impacts is the time delay for deliveries of materials to and from downtown offices. In particular, truck delays affect business costs for manufacturing, wholesale, and transportation firms, but also affect office businesses. The difference in areawide average daily travel time for truck trips to and from downtown Boston (Proposed Action versus 2010 baseline) is estimated to be 4 minutes, representing an additional cost of $1.60 per truck trip.

The Proposed Action will allow the employment to continue to grow as currently forecasted. Forecasts of study area office employment for the period 2000 to 2010, assuming the Artery/Tunnel Project is completed, include 33,000 additional jobs in finance, insurance, and real estate, in business services, and in professional services. It is expected that 20 percent (or 6,600) of these additional office jobs in the Central Area would not occur without the Artery/Tunnel Project. Thus, the project provides a direct benefit of 6,600



Source; Cambridge Systematics, Inc., Downtown Boston Office Survey

FIGURE 7.12

Current Office Tenant Mix In Downtown Boston And Suburbs 1988

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

office jobs. Total project impacts on employment are significantly greater than these figures, due to further direct effects discussed in Sections 7.2.3 through 7.2.7.

The NECMA metropolitan area would have 5,000 office jobs at stake, since some downtown office jobs could be relocated. The overall direct, indirect, and induced impact of these office jobs is 10,300 total jobs at stake in the NECMA metropolitan area. In addition, there are further jobs at stake in the study area and elsewhere in the metropolitan area, which are related to retailing, tourism and industry (totalling 17,800 jobs at stake in the NECMA).

7.2.3 Retail Business Impacts

It is expected that overall retail sales in the metropolitan area will grow to over $21 billion in the year 2010, under either the Proposed Action or 2010 baseline conditions. However, some retail sales in the project study area would be lost if the Proposed Action is not carried out. Under 2010 baseline conditions, the study area would lose $10 million in retail sales annually compared with conditions under the Proposed Action. Some of the sales lost in the study area would be regained elsewhere in the metropolitan area. However, a loss of office jobs and tourism, not fully recouped elsewhere in the metropolitan area, would reduce overall retail sales. This conclusion is based on analysis of the retail sales contributed by various different retail market segments, evaluation of their sensitivity to auto access and increased traffic, as well as from case studies of experiences elsewhere.

7.2.3(a) Overall Retail Sales

Classification Of Impacts. In order to evaluate retail impacts, it is necessary to understand the makeup of the retail customers within the study area. Retail activity in the study area is distributed over several distinct retail districts. Each will be affected by the Artery/Tunnel Project to a different extent, depending on the nature of its customer base. The major customer types attracted to shop in the study area's retail districts may be divided into five categories:

- o downtown (office) workers
- o neighborhood residents
- o suburban residents
- o occasional visitors (tourists)
- o construction workers

Each category of customer has a different reason for being in one of the retail districts under study, and consequently might be expected to respond differently to increased congestion or difficulty in access to retail businesses without the Proposed Action. Their responses are closely tied to the character of the retail business (or business district) they patronize. Each of the following types of retail activity would be affected under the 2010 baseline condition in the following ways:

- o walk-in traffic:
  - from nearby offices and nearby residents is not expected to be affected
  - from other City residents coming to downtown by public transportation is not expected to be affected as long as basic bus availability is maintained

- o drive-in traffic to downtown stores and restaurants:

  - from metropolitan area residents would potentially be negatively affected by any loss of nearby parking, increase in travel time, or excessive traffic congestion

- o out-of-town visitor traffic:

  - would potentially be affected if the area's reputation concerning accessibility causes a decrease in visitation

In addition, retailers in the study area depend upon regular deliveries of finished goods and raw materials to maintain their inventory of products for sale, and some businesses must distribute and deliver their merchandise to customers. A slowdown of regular servicing of either sort due to increased congestion could increase the cost of doing business and affect the business's profitability.

Differences In Customer Base. The central retail district in Boston services the entire metropolitan area and includes three major retail areas -- the Downtown Crossing area, the Faneuil Hall Market Place area, and the Back Bay area. The Back Bay area further subdivides into Copley Place, the Prudential Center, and the Newbury and Boylston Street "strips." Of these districts, Faneuil Hall Market Place is frequented by tourists, and Copley Place in Back Bay is frequented by convention and business visitors. Other major retail districts frequented by regional shoppers and out-of-town tourists are the North End and Chinatown.

Other small concentrations of retail activity are located in the Financial District, the Waterfront, the North Station area, and the South Station area. In addition, there are neighborhood retail districts in Charlestown, East Boston, South Boston, and the West End/Charles Street area, as well as the North End and Chinatown.

Neighborhood-oriented businesses, including neighborhood food and apparel shops, tend to rely on walk-in customers and thus would be less likely to be negatively affected by increased congestion without the Artery/Tunnel Project. On the other hand, businesses serving a regional clientele, particularly those offering higher priced and higher value goods to a predominantly car-oriented customer base, would be more likely to be negatively affected by increased areawide traffic congestion under baseline conditions.

Sales Impacts. Retail sales generated by walk-in traffic from downtown office workers account for nearly half of the retail sales in the Downtown Crossing, Faneuil Hall Market Place, and Back Bay areas. That component of retail sales is not expected to be affected. Retail sales generated by walk-in traffic from local residents account for over two-thirds of the retail sales in most of the neighborhood shopping areas. That component of retail sales also is not expected to be affected. Retail sales generated by tourists would be slightly reduced under baseline conditions due to a reduction in tourist trips (as discussed in Chapter 3).

The downtown worker shopping population also would be affected under 2010 baseline conditions. Although walk-in access to shops would not be affected, the increase in traffic congestion under 2010 baseline conditions would likely cause a slowdown in office growth as compared to the Proposed Action (as described in detail in Section 7.2.2).

Retail sales generated by regional residents who drive in to downtown are expected to decline under baseline conditions, due to the increased length of time and difficulty of access. Of shoppers in the study area, those coming by car make up 13 percent. With the traffic congestion that would result from 2010 baseline conditions, this segment of shoppers in the study area would remain approximately constant after the year 2000, rather than continuing to grow. However, nearly all of the additional sales not occurring in the study area under 2010 baseline conditions would be merely shifted to suburban shopping locations.

With the Proposed Action, the direct impact on total study area retail sales in the year 2010 is estimated to be $50 million (1987 dollars). The total direct, indirect, and induced impact on Suffolk County retail sales is $110 million. These total retail impacts reflect further changes expected in office development and tourism, as well as the direct impacts on retail spending patterns. Metropolitan retail business sales in the year 2010 are projected to grow by $85 million, reflecting the fact that some retail sales losses in Suffolk County are shifted to suburban locations. These total retail impacts reflect further changes expected in office development and tourism, as well as the direct impacts on retail spending pattern (See Table 7.20).

7.2.3(b) Established Business Districts

The following describes localized retail impacts. See Section 7.1.1(d) for descriptions of the retail areas.

Downtown Crossing. The Proposed Action will prevent loss of a part of the segment of retail shoppers who arrive by automobile. Sales of higher priced merchandise are particularly vulnerable to any such losses of shoppers coming in by car. The specialty retailers selling jewelry, fur, and cameras are most vulnerable insofar as their clientele tends to come in by car rather than public transit, due to the value or bulk of the merchandise.

Financial District. Retail establishments in the Financial District represent an extension of the Downtown Crossing retail district, but are heavily oriented towards restaurants, personal services, business services, and convenience goods serving the office worker market. The overall impact of the Proposed Action on retail sales in this district will be limited to effects of constraints on employment growth.

Faneuil Hall/Haymarket. Faneuil Hall Market Place and Market Place Center directly abut the Central Artery. Traffic congestion to reach Faneuil Hall Market Place would discourage some visits by suburban residents under 2010 baseline conditions.

The larger share of retail sales generated by office workers and area residents coming in by public transit is unlikely to be affected as long as the environmental quality of the pedestrian shopping experience remains constant. The impact on sales generated by tourists will depend on overall changes in tourism (See Section 7.2.5). Overall, some loss of tourist visits would occur under 2010 baseline conditions, although the viability of Faneuil Hall Market Place would most likely not be affected.

North End. Many North End restaurants and retailers depend heavily on out-of-town customers. Some of these are customers passing by in the automobile traffic coming through the tunnel from East Boston; some drive in from the suburbs, park, and walk there as part

of an in-town shopping trip; and some are pedestrians crossing the Central Artery from downtown.

Businesses that rely on both foot and automobile traffic access, such as the small retailers on Cross Street and restaurants on Hanover and Salem Streets, would likely experience a drop in customer traffic under the 2010 baseline conditions.

Some businesses in the North End serve both retail and wholesale markets, and unimpeded deliveries of goods and raw materials to local businesses are as important as the delivery of goods to customers outside of the North End. Delivery delays that would occur under the 2010 baseline conditions would impact North End businesses.

Back Bay. Copley Place and Prudential Center retail sales are largely dependent on adjacent hotel and conference visitors, nearby office workers and their business visitors, nearby apartment residents, and affluent shoppers who drive in. (Most of the car traffic for shopping is from the western suburbs, due to the direct Massachusetts Turnpike ramps serving that direction.) Impacts of the Artery/Tunnel Project on these groups are likely to be minimal. The primary impacts will be related to any changes in convention bookings, which are also expected to be minimal, as discussed in Section 7.2.5.

The Newbury Street retail district serves a broad regional market. The art galleries, boutiques, and upscale specialty apparel shops attract visits by affluent residents from throughout the City and metropolitan area. These groups reach the area by car and public transit. Car access from the west via the Massachusetts Turnpike will be unaffected by the Artery/Tunnel Project. Access from the north is via Storrow Drive, which could be affected by rerouting of spillover traffic under baseline conditions. Direct highway access from the south is currently unavailable except via local downtown streets, which will be much less subject to congestion when the Proposed Action is completed. Boylston Street retail includes restaurants and various merchandise and serves area residents, students, and office workers. These groups will be affected only minimally.

Chinatown/South Cove Area. Most of the businesses in Chinatown are restaurant, wholesale grocery, and service establishments rather than comparison shopping stores. Discussions with several area business leaders indicate that the well established businesses will most likely not be affected by the Artery/Tunnel Project, as they represent destination businesses with strong patron allegiance.

7.2.4 Industrial, Wholesale, And Maritime Business Impacts

The Artery/Tunnel Project study area has a substantial industrial/manufacturing sector. Over 54,000 people are employed in industry and manufacturing. There is a potential for a long-term loss by manufacturing businesses in the study area without the Artery/Tunnel Project. Manufacturers and wholesalers rely on road transportation within and through the City and access to and from the airport and seaport to ship their products. With the increase in traffic under 2010 baseline conditions, trucks would be delayed, which would add to the cost of doing business. These costs are explained in more detail in Section 7.2.9. The areawide average delay reduction for the Proposed Action compared with baseline conditions will be 4 minutes, while the PM peak hour reduction in delay for travelling the length of the Central Artery within the study area will be 15 minutes. The added delay for

trucks under baseline conditions would cost businesses in the metropolitan area $183 million in lost business sales and would result in 1,677 lost jobs.

There are a large number of trucks passing through the study area which travel on the Central Artery. Many truck trips do not originate in the City of Boston or in the metropolitan area. These trips also would have costs associated with potential delay under 2010 baseline conditions, as discussed in Section 7.2.9. The added delay would cost companies $85 million annually for truck driver and operational expenses, excluding gasoline.

Three types of trucking activity would be affected by losses resulting from an increase in truck delay under 2010 baseline conditions. First, there are delivery trucks that service downtown businesses, such as restaurants and stores, and which need to get into and around downtown. Next, there are regional deliveries, involving firms accessing the region to make and receive shipments. These involve establishments such as the Chelsea Food Market, newspaper deliveries, and the flower and meat markets at the south edge of the study area, as well as the airport and seaport. Lastly, there are interstate deliveries for which trucks travel through Boston to and from their destinations.

Airport And Seaport-Related Businesses. Specific data on the spatial distribution of the truck traffic in the study area are not available, although it is known that a large share of that traffic is attributable to trips to and from Logan Airport. Additional traffic is generated by container shipments to and from the port facilities located in South Boston and Charlestown. In particular, trucking firms currently carry merchandise including high-technology goods to and from Logan Airport. These trips increasingly are being delayed by traffic tie-ups. As a result, an increasing number of Massachusetts companies are shipping their goods through New York and Connecticut (Bradley Field) to avoid the expensive delays at Logan Airport.

Several subareas contain concentrations of airport-dependent industrial activity, including South Boston/Fort Point Channel, South Bay/Newmarket/South End, and industries near Logan Airport in East Boston. Industries located at the airport include cargo and overnight package shippers, warehousing and freight forwarders, airline food service, airplane hangars and servicing, and fueling facilities. Additional seaport-related industrial activity including the General Ship facility is located in South Boston.

Potential long-term impacts under 2010 baseline conditions would be predominantly in the form of delays in truck access between the airport and points throughout the metropolitan area, particularly points to the west and south, as well as downtown and elsewhere in the project study area. Overnight delivery businesses, freight truckers, and warehouses located at the airport will incur greater costs when time-sensitive pickups and deliveries throughout the Callahan Tunnel and Central Artery slow down due to congestion. Secondly, firms throughout the study area and the rest of the metropolitan area whose business requires shipping products through the airport (e.g., seafood and fish distributors and manufacturers of specialized instruments and medical products) or through the seaport (e.g., container cargo) would incur extra costs as a result of delays of shipments.

There are several other categories at airport-related businesses affected. The freight consolidators and freight handlers arrange for delivery services and clearing freight

through customs. This often involves running couriers back and forth through the Callahan/Sumner Tunnels to the U.S. Customs Office in the T.P. O'Neill Jr. Federal Building. Those trips are particularly sensitive to tunnel delays and will experience increased costs under baseline conditions.

In addition to freight shippers, many firms in the East Boston airport area are suppliers to the airlines, including caterers and airplane servicing. They, too, are dependent on maintaining adequate tunnel and Central Artery traffic flow, and would be hurt by traffic delays under 2010 baseline conditions.

The Proposed Action, in particular the Third Harbor Tunnel, will help allow airport-related businesses to keep up with projected Logan Airport activity. The new tunnel, unlike the existing tunnels, will allow passage by full-size trucks. This will provide airport-related businesses with a more direct route to downtown Boston and points west and south.

South Bay/Newmarket/South End. There is a wide variety of industries in this subarea, including food and flower distribution, as well as major manufacturing. Flower wholesalers and distributors located in the Newmarket area receive shipments from around the world by air. Both the flower market and the Newmarket area concentration of meat and frozen food wholesale and distribution firms depend on truck access to the Central Artery for delivery to and from points north and west. Some industries in the South End, such as the Boston Herald newspaper, make off-peak deliveries and shipments in early morning hours. Under baseline conditions, these businesses would incur greater cost and lose business sales due to travel delays along the Artery. With the Proposed Action, the business costs of delay in accessing the airport and destinations to the north will be reduced.

South Boston/Fort Point Channel. The Boston Marine Industrial Park currently has over 100 manufacturing, wholesale, and service industries. One of the largest industries at the site is food processing. Seafood processing also occurs at the nearby Fish Pier. Many of these food suppliers serve downtown hotels and restaurants, and good access for truck deliveries to downtown is critical to these industries. Other industries at the site, such as apparel manufacturing and related finished textile products, ship their products nationally, and therefore rely on highway and airport access for shipping. Other industries in South Boston, including trucking companies and heavy manufacturers, rely heavily on local road access. This area already has some congestion at the bridges across the Channel, which would be exacerbated if traffic circulation problems were allowed to worsen under baseline conditions. The Proposed Action will provide the area with a direct access link to East Boston and the airport, making it more attractive for airport shippers, and will reduce delays for deliveries from area businesses to downtown customers.

Third Harbor Tunnel/Boston Harbor. Under the Proposed Action, the depth of the ship channel to the top of the rock cover over the Third Harbor Tunnel has been revised from 45 feet to 40 feet below mean low water level. This will preclude deepening of the existing 40-foot-deep channel for that portion of Boston Harbor between the Third Harbor Tunnel and the MBTA Blue Line transit tunnel, which also limits channel depth to 40 feet. Facilities at the Reserved Channel, for example, would not be affected. The only wharves for which future deepening of the channel could be considered appropriate are the Massport East Boston wharves intended for future industrial or residential use. Massport has agreed to the reduction to 40 feet with the understanding that the 40-foot depth includes the full width

of the channels (inbound and outbound). It is understood that Massport's development plans for the East Boston wharves do not include serving vessels that would require channel deepening. The U.S. Army Corps of Engineers has indicated that its future plans for the navigation channel in the vicinity of the tunnel involve a widening to 1,200 feet while maintaining the current 40-foot depth. In addition, a recent U.S. Army Corps of Engineers study (Deep Draft Navigation Feasibility Study, revised August 1986) concluded that "it appears that such major deepening improvements are not economically justifiable" with respect to channel deepening to greater than 40 feet. More recent plans by the Corps of Engineers (August 1988) call for dredging certain portions of the channel to 40 feet, which is likely to determine marine terminal development for many years to come.

In view of the limited wharf area remaining to be developed and the lack of any shipping proponent for vessels that would require a 45-foot-deep channel, it is concluded that future development opportunities will not be sufficient to make the channel deepening between the Third Harbor Tunnel and the MBTA Blue Line tunnel economically feasible. It appears, therefore, that there will be few, if any, economic losses associated with the foreclosure of this possibility of deepening the channel beyond 40 feet as a result of the construction of the Third Harbor Tunnel as presently proposed.

7.2.5 Residential Impacts

The long-term impacts of the Artery/Tunnel Project on apartment rents, housing values, vacancy rates, and absorption of new units in the study area are expected to increase the overall value of housing due to the enhanced livability and the aesthetic improvements to the City, as well as an increase in jobs available in the area. As a result, housing development activity and prices are expected to increase beyond levels that would be likely without the project.

Several trends in the Boston housing market may continue to affect the corridor neighborhoods once the project has been completed. Condominium ownership has attracted more affluent people to move to or remain in the City. If this trend continues and is accelerated by the anticipated move of people into the City during the construction period, there will be continued pressure to upgrade housing in the City neighborhoods. Development interest in other neighborhoods also could grow as middle income persons seek housing.

The current demand for affordable housing, either for sale or for rent, is likely to continue even if incomes rise substantially, because of the anticipated population growth of the City and competition for housing. Neighborhoods like South Boston and East Boston, where rentals and condominium prices are lower on average than in other areas, will feel the greatest price pressure at the lower end of the market. Households trying to find or keep affordable housing will have some difficulty, if rents and home prices continue to rise.

In general, increased accessibility as a result of the Proposed Action should positively affect the study area as a place to live. In the case of the West End/North of Causeway/Beacon Hill/North End/Waterfront areas, the improved accessibility between formerly disconnected neighborhoods will make it possible to "reknit" these once adjacent sections and to create a stronger, cohesive, and more attractive residential community.

The Artery/Tunnel Project will help eliminate truck traffic on local streets in South Boston and commuter traffic seeking shortcuts through East Boston streets. Both of these traffic

problems currently are considered negative factors for the marketability of properties in those areas.

A second route from downtown into East Boston will put downtown within easier reach of that community, potentially opening East Boston to increased interest in owner and renter housing. Improved access via the Third Harbor Tunnel should improve the attractiveness of the sections of that community along the existing access routes to the Callahan Tunnel, as traffic volumes are lowered, and in the residential sections south of Porter Street, as traffic and noise shift north along with the new highway.

The attractiveness of Charlestown as a residential district should be enhanced as traffic congestion on local streets is lowered as a result of traffic moving more quickly onto the Artery and of fewer commuters looking for shortcuts through the local neighborhood streets.

Downtown Boston will be enhanced as a residential district as accessibility in and around the Central Artery is improved. There is an opportunity to provide good pedestrian connections through the new parcels above the Artery and to improve the accessibility of the North End and Waterfront neighborhoods.

The completed Artery/Tunnel Project will improve access into and out of Beacon Hill and Back Bay. Both are likely to remain popular areas to live in, and improved accessibility and safety will only enhance their appeal.

The segment of the South End abutting Albany Street and closest to the Central Artery is a densely built area with housing located on side streets, mixed with warehouses, industrial sites, and institutional uses. As residential areas currently are separated from the Central Artery by Albany Street and industrial land, this residential area should not be affected to a major extent by the project.

7.2.6 Tourism Impacts

The long-term impact of the Artery/Tunnel Project on tourism in Boston will be positive, although the rate at which tourism may grow is uncertain. The project will allow tourism to continue to grow, while without the project (the 2010 baseline) tourism would still grow but at a slower rate due to the difficult accessibility of downtown Boston.

The uncertainty results from the fact that many other factors affect tourism more than transportation access alone. Tourism activity in Greater Boston has been growing in recent years, with visitation on the rise, new hotel construction, and the opening of an expanded Hynes Convention Center. The tourism industry also has benefited from a national growth trend in tourist activity. However, the future of this growth trend relies on many factors. Nationally, tourism and convention business is increasingly competitive, and Boston must maintain its current competitive position for the industry to continue to prosper. Factors such as the future of State funding on tourism promotion, the quality of current services as perceived by convention planners (and compared to other cities), as well as weather, transportation accessibility, and other annual fluctuations in the visitor package all impact the rate at which tourism will grow in the future.

With the Artery/Tunnel Project completed, it is estimated that there will be 10.6 million visitors to the Boston area in 2010, a 46 percent increase from 1985. On the other hand,

under baseline conditions, it is estimated that visitation would be 10.0 million, a 30 percent increase over 1985 (see Table 7.21). This analysis is based on tourism data from the Greater Boston Convention and Visitors Bureau and the Massachusetts Division of Travel and Tourism. It is also based on interviews and discussions with members of the tourism industry in Boston and on data provided by some area attractions.

The projections shown in Table 7.21 are estimates of future visitation to year 2010. The estimates are based on an extrapolation of predicted growth through 1990 by Pannell Kerr Forster in a report entitled An Economic Impact Study of the Tourism and Convention Industry for the Greater Boston Area, with an estimated growth beyond 1990 at one-half of their pre-1990 rate to account for the fact that tourism activity cannot sustain the recent rate of growth for an extended period.

The long-term effect of the project on tourism activity depends on how access is improved for different types of visitors. The three primary market segments in the visitor population, defined by the primary purpose of the trip, are:

- the tourist segment, including those who visit Boston for pleasure purposes
- the commercial or business segment, including individual business travellers
- the convention/meeting segment, including those who attend meetings or conventions in the area

There are some remaining visitors counted in the data sources who are permanent residents and others who use hotels in the area. This group is not significant for this analysis, because it is small and does not tend to be affected by traffic and congestion.

According to the Massachusetts Division of Travel and Tourism report on Travel in Massachusetts in May, 1987, approximately 16 percent of visitors to the Boston area are from the six New England states. The remainder includes a large percentage of visitors (38 percent) from the Mid-Atlantic states of New Jersey, New York, and Pennsylvania. Visitors from close to the Boston area are more likely to travel to the City by car and subway, whereas those coming from farther away are more likely to come to the City by train, bus, or plane. Those using automobile access would be more likely to be dissuaded from coming downtown if traffic congestion were greater, as it would be under baseline condition.

Pleasure travellers or tourists tend to travel more by car, with a smaller portion coming by other modes of transportation. Business and convention travellers, on the other hand, tend to travel by car and plane almost equally. Those coming by bus and car are likely to benefit most from easier highway access into the City, whereas those coming by plane and train will benefit less because they will use public transportation of some type once they reach the City. This distinction was used to determine relative long-term benefits to the market segments from the Artery/Tunnel Project in Boston.

There is a wide variety of tourist destination areas within the project study area. These are discussed below, to assess relative magnitudes of types of groups attending the various attractions and potential dependence on road access into the City.

Table 7.21

PROJECTED TOURISM ACTIVITY UNDER BASELINE AND PROPOSED ACTION

	1985		Proposed Action - 2010		2010 Baseline	
	Visitors	Expenditures (Millions)	Visitors	Direct Expenditures (Millions)	Visitors	Direct Expenditures (Millions)
Tourists						
Hotel/Motel	993,700	$ 356.4	1,533,300	$ 549.0	1,384,400	$ 496.5
Visit Friends and Relatives	1,395,300	315.0	1,789,400	404.0	1,685,000	380.4
Day Trippers	1,482,700	95.2	2,022,700	129.9	1,877,600	120.6
Total	3,871,700	$ 766.8	5,345,400	$ 1,083.8	4,947,000	$ 997.5
Business						
Hotel/Motel	1,582,000	$ 801.9	2,441,000	$ 1,237.0	2,399,700	$ 1,216.4
Visit Friends and Relatives	155,000	35.0	198,800	44.0	196,800	44.0
Day Trippers	550,700	35.4	751,200	48.3	742,100	47.7
Total	2,287,700	$ 872.3	3,391,000	$ 1,330.5	3,238,600	$ 1,308.1
Convention						
Hotel/Motel	733,000	$ 463.3	1,358,900	$ 858.0	1,262,600	$ 798.0
Day Trippers	84,700	5.4	117,000	7.4	112,500	7.2
Total	817,700	$ 468.7	1,475,900	$ 866.4	1,375,100	$ 805.2
Others[1]	301,500	160.0	386,700	205.2	386,700	205.2
Total	7,278,000	$ 2,267.0	10,598,900	$ 3,485.0	10,047,400	$ 3,316.0

1. Permanent residents and others using hotels

Source: Cambridge Systematics, Inc., based on growth projections by Pannell Kerr Forster

Waterfront/Faneuil Hall Market Place. The Waterfront/Faneuil Hall Market Place area is comprised of two separate destinations, currently divided by the Central Artery structure. Faneuil Hall Market Place is a "festival market place" largely oriented towards retail shopping and eating and drinking, with some historical interest. It is a destination for many regional and out-of-town visitors as well as local business people both during the day and at night. Faneuil Hall Market Place is on the downtown side of the of the Artery, adjacent to the financial and government districts. Many tourists walk to Faneuil Hall Market Place from their hotels and from other downtown locations. A large number of tour buses make stops at Faneuil Hall, stopping for periods of time primarily along Congress Street and other adjacent areas.

Across the Central Artery from Faneuil Hall Market Place, the Waterfront includes several hotels, the New England Aquarium, and Long Wharf, where the boats dock for cruises to the Boston Harbor islands and elsewhere. The Aquarium is currently a destination for regional as well as out-of-town travellers, although it is planning to relocate to larger quarters in Charlestown. The hotels serve both business and pleasure visitors. Restaurants and bars at the hotels also have a large patronage of local residents and office workers. Some visitors walk to the Waterfront from other attractions or from their hotels. Many whose destination is the Aquarium, drive and park in one of the Waterfront garages, while others arrive via the Aquarium subway stop.

Fort Point Channel. The Fort Point Channel area is also along the Waterfront, across the Central Artery and the Congress Street bridge. The major attractions are the Boston Tea Party ship and the Children's and Computer Museums.

The Tea Party ship is an historical attraction, drawing a large number of tour buses and out-of-town pedestrians who are visiting many historical sites in the City. The Tea Party ship and other historical sites are usually not sole destinations, but rather are generally part of a City tour. Therefore, good pedestrian and bus access to and from the Fort Point Channel area is important to maintain patronage. The Tea Party ship and other Fort Point Channel attractions will benefit from improved access into the area, both for auto visitors and pedestrians who no longer have to cross the above-ground Central Artery structure.

The museums are destination attractions, particularly by regional visitors who come to the City mainly for the purpose of visiting the Children's Museum or the Computer Museum. Many of these visitors tend to drive to the attraction. Therefore, improved highway access should particularly benefit these types of attractions.

North End. The North End contains a variety of historical attractions, including the Old North Church and the Paul Revere House, which attract out-of-town tourists visiting all of the sites along the Freedom Trail, which links the North End to the rest of downtown. Once the barrier of the existing Artery structure is removed, the North End will become even more appealing to pedestrians, encouraging Freedom Trail walkers to continue into the North End.

Also of interest to visitors to the North End is the large variety of bakeries, restaurants, and grocers. These ethnic establishments draw many visitors, regional and local, into the North End. In the absence of the project, congestion will deter some of these customers as well as the drive-by traffic on which many small North End businesses rely.

Charlestown. Charlestown has a number of historic sites, including the Bunker Hill Monument, the Charlestown Navy Yard, and the U.S.S. Constitution. Most visitors to these sites drive or take some form of public transportation to them. Charlestown is separated from downtown Boston by water and a bridge, which cuts it off from pedestrian flow. The Artery/Tunnel Project should increase visitation to these sites by reducing local street congestion and providing easier access to the City.

Citywide. The Freedom Trail and the Black Heritage Trail both draw visitors throughout the City. Both include stops at historic sites across the City. The project is most likely to benefit those using the trails where they cross the Central Artery. A more attractive pedestrian environment above and around the Artery will encourage visitation between downtown sites.

The trolley tours which bring tourists all over the City have to reach all historic and other sites on City streets. Improved access throughout downtown will benefit the trolley tours.

The Tourist Segment. Of the 7.3 million visitors to the Greater Boston area in 1985, approximately 53 percent, or 3.9 million, were tourists, those visiting the area attractions for pleasure. This group was responsible for $767 million in direct visitor expenditures in the area.

Attractions currently separated from downtown by the Central Artery structure, such as those on the Waterfront or to the east and north of the highway, will benefit from more convenient and appealing pedestrian and auto access in the long term as a result of the Artery/Tunnel Project. Those regional attractions that depend heavily on auto patronage will also benefit from improved access into downtown.

The increased accessibility of the downtown area will enhance overall tourist visitation to the City and the region by creating the perception that Boston is an easier and more pleasant place to get to as a result of the project. Under baseline conditions increased traffic congestion would cause tourist visitation to suffer somewhat.

Permanent loss of downtown parking for tour buses is potentially a negative long-term impact. Steps will be required to provide alternative and well publicized parking to mitigate the potential impacts of parking loss on the tourism industry.

With the Proposed Action, it is expected that the tourist sector will increase to 5.3 million visitors by 2010, a 38 percent increase over current levels. Annual expenditures by tourists in 2010 are estimated to reach $1.0 billion. Under baseline conditions, tourist visitation would likely grow at a slower rate after the year 2000, given the difficulty of access into the City. The estimated impact is a difference of 400,000 visitors generating $8 million in annual expenditures. Under baseline conditions, it is estimated that approximately half of the tourists who stay at hotels or visit the City for the day may choose not to visit downtown sites due to congestion, and instead visit or stay in other parts of the metropolitan area. Some visits to friends and relatives in the metropolitan area also would be lost. Therefore, Boston would lose visits in the 2010 baseline condition, but the overall metropolitan area would regain some visits elsewhere.

The Business/Commerical Segment. Approximately 31 percent of the 7.3 million visitors to the Greater Boston area in 1985 were individual business travellers, who came to the area for business purposes. Total business/commercial expenditures were $872 million.

Many business travellers come to the City by airplane and access downtown by public transportation or taxis. Many regional business travellers drive to the City. The business traveller is not as affected by changes in parking and access as the discretionary pleasure traveller. As long as it is necessary to conduct business in the City, business people will reach their business destination. Therefore, whether or not the business travel industry remains healthy in the long run depends on whether the office market and local economy in Boston remain strong.

In general, visitor destinations of business travellers are the hotels, located in a number of places around the City, with a large concentration of them away from the project area in the Back Bay neighborhood. Several hotels are located adjacent to the Financial District, not far from the Central Artery, but on the downtown side of the highway. The weekday traffic from business travellers to these locations should not diminish as long as a healthy business economy is maintained in the City.

Another group of hotels near Faneuil Hall and along the Waterfront will also be more attractive once the project is complete and the overhead structure is removed.

It is estimated that any impact on expenditures of the business/commercial segment of the tourist industry after completion of the Artery/Tunnel Project will be related to the long-term office economy, which is projected to grow less without the project. It is estimated that there will be approximately 3.4 million business visitors in 2010, spending approximately $1.33 billion with the Proposed Action. Under baseline conditions, business visitors are estimated at approximately 3.3 million with $1.29 billion in annual direct expenditures, approximately $40 million less than under the Proposed Action.

The Convention Segment. The convention segment makes up 11 percent of Boston's visitor industry, contributing $469 million in direct expenditures. Convention and meeting visitors come from a regional and national market. Many are likely to enter the City by air, while some regional conventions will draw automobile drivers. Therefore, access by public transportation as well as adequate parking are crucial to continued success of the convention business in Boston.

Regional conventions, which rely heavily on auto access by their attendees, are likely to be more attractive. The perception that Boston is easier to access and more pleasant to travel in should provide a positive benefit to convention business overall.

Given that the convention business is highly competitive, it is likely that increased traffic congestion in the 2010 baseline conditions would result in a lower level of convention business than with the implementation of the project. Approximately 1.48 million convention visitors are expected in 2010, with $866 million in direct expenditures. The number of annual convention visitors in 2010 without the project is estimated at $1.38 million, with $805 million in annual direct expenditures, or about $60 million less than under the Proposed Action.

Other Types of Visitors. A small group included in the tourism statistics are permanent residents and others using hotels. They are not expected to be impacted by the Artery/Tunnel Project, and the growth projected for this group is not expected to change as a result of it.

Summary Of Long-Term Impacts On Tourism. It is estimated that direct impact of $169 million of additional tourism spending in Suffolk County will occur by the year 2010 under the Proposed Action compared to 2010 baseline conditions (see Figure 7.13). This includes $57 million for lodging and food service spent at hotels and motels, $52 million spent at restaurants, $16 million spent on nonfood retail purchases, and $44 million spent on entertainment, recreation, automobile rental, and other services. The total spending difference represents an overall loss of 5 percent in tourism expenditures without the Artery/Tunnel Project.

The total direct, indirect, and induced impacts of this tourism loss is estimated to be 5,600 jobs and a total business sales of $270 million in Suffolk County in the year 2010. This includes an estimated 1,900 restaurant and retail jobs, 3,020 hotel and service jobs, and 680 jobs in other economic sectors. Since some of the regional tourism gained for Suffolk County will otherwise occur elsewhere in the metropolitan area, the overall metropolitanwide impact is a more modest 4,300 jobs. These total impacts include effects on retail activity included in the discussion on retailing in Section 7.2.3.

7.2.7 Impact On Institutions

There are a number of institutions in the study area. They are summarized in Section 7.1. These include five major hospitals (Boston City, New England Medical Center, Massachusetts General, Massachusetts Eye and Ear, Spaulding Rehabilitation, and University Hospital). It is expected that, in general, the Proposed Action will have a mixed but generally positive economic impact on institutions in the study area.

On the positive side, easier access into downtown will make hospitals potentially able to draw employees from a wider area of the State. Better access can also attract more highly skilled employees and help retain existing employees.

On the negative side, the new ramp locations will require some employees and patients to take a more circuitous route to reach the hospitals. In particular, the Nashua Street/North Station area may experience more congestion, delaying peak hour access to Spaulding Rehabilitation Hospital.

In general, with improved accessibility for activities such as ambulance service, deliveries, and visitors, the function and economic condition of the hospitals will improve with increased access and improved traffic flow.

The New England Medical Center has plans to construct four new buildings totalling 500,000 square feet over the next 10 to 15 years. Massachusetts General Hospital has two large construction projects underway. Improved access into the City will support the plans for growth of these and other institutions.

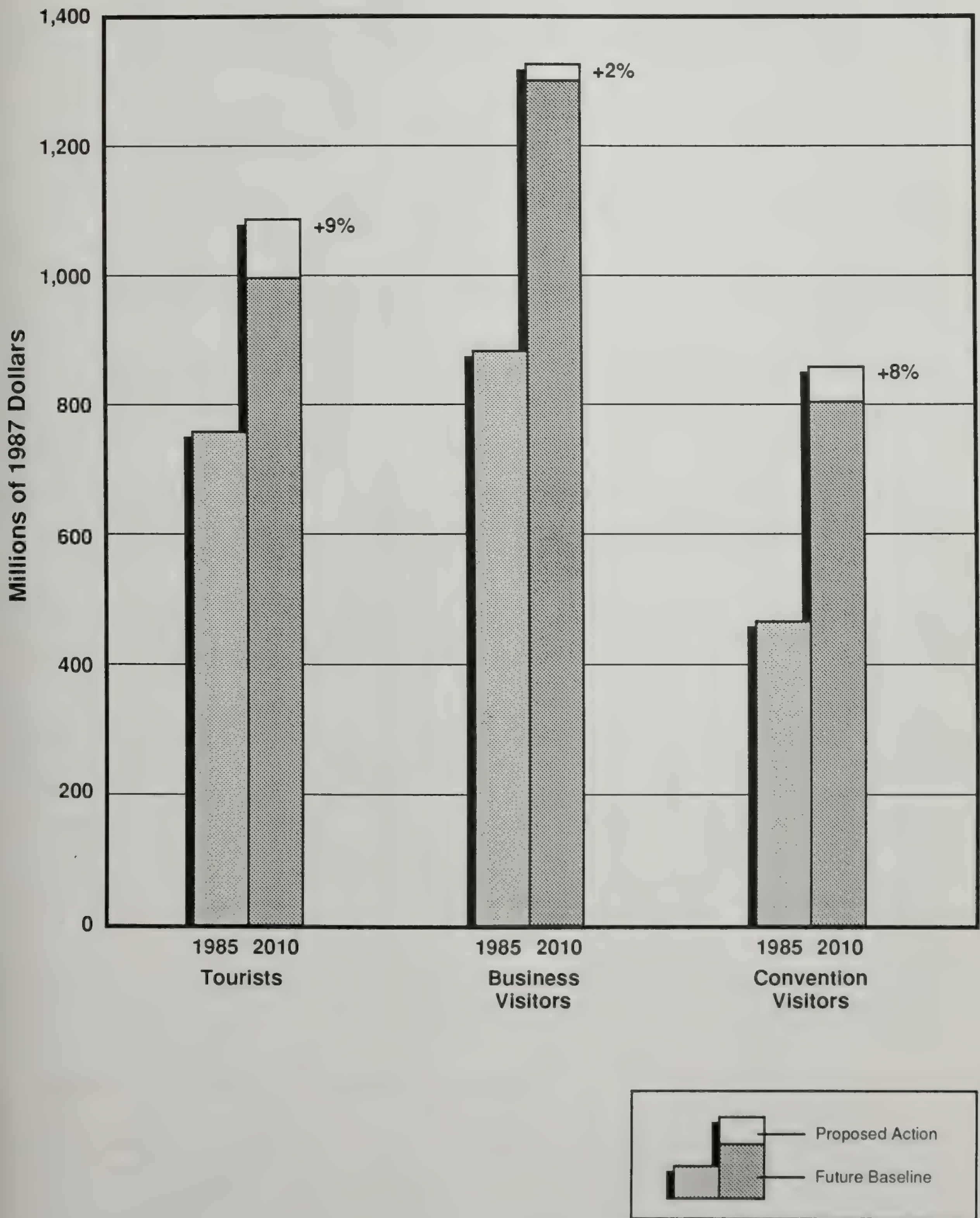


FIGURE 7.13

Projected Tourism Expenditures For Greater Boston Area

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

7.2.8 Overall Impacts On The Economy

Overall impacts on the economy are a cumulative result of all of the specific impacts discussed in Sections 7.2.2 through 7.2.7. In particular, direct employment impacts will occur as a result of four key categories of changes:

- o Direct office growth impacts attributable to differences in commuting cost and highway system capacity
- o Direct retail shifts attributable to differences in downtown versus suburban travel accessibility
- o Direct manufacturing and wholesale growth impacts attributable to differences in trucking/delivery costs
- o Direct tourism/visitor growth impacts attributable to differences in downtown travel conditions

Further indirect and indirect impacts fall into two major classes:

- o Further growth in office industries (finance, insurance, and real estate), as well as business and professional services, required to support and serve the additional business activity that is created as a direct result of the Proposed Action.
- o Further growth in retailing and services, and hence also wholesaling, resulting from the additional spending generated because of additional local employment and income created as a direct result of the Proposed Action.

The REMI economic forecasting model projects total changes in Suffolk County and metropolitan area employment resulting from the direct, indirect, and induced impacts on the City of Boston and metropolitan area economies. It shows the "spin-off" effects on Suffolk County and the metropolitan area, which includes impacts on jobs in manufacturing, retail, wholesale, finance, and services. These include impacts on employment in administrative, professional, and clerical occupations, as well as sales and services occupations. Table 7.22 shows the forecast difference in number of jobs by industry in the year 2010, under conditions that will result from the Proposed Action, and under 2010 baseline conditions.

The overall employment impact, by the year 2010, is 20,700 more jobs in Suffolk County and 17,800 more jobs in the metropolitan area with the project, compared to the 2010 baseline conditions.

7.2.9 Transportation System Efficiency Benefits

Completion of the Artery/Tunnel Project will provide time savings benefits to a wide variety of automobile and truck travellers to and from downtown Boston, through downtown Boston, or around the Boston area as part of longer trips. Some of these benefits have been accounted for in the economic impact analysis through their effects on business costs. These include the value of time savings for business truck travel and downtown commuters. Other classes of time savings, including those for all personal (nonwork-related) travel and through truck travel, have no direct effect on the local economy.

Table 7.22

TOTAL SUFFOLK COUNTY AND METRO EMPLOYMENT IN YEAR 2010

	Suffolk County		
Industry	**Baseline**	**Proposed Action**	**Impact of Proposed Action**
Manufacturing	26,018	25,925	-88
Construction	15,158	15,422	264
Wholesale	16,720	16,987	267
Retail	73,590	78,420	4,830
Finance, Insurance, Real Estate	129,250	134,213	4,963
Transport, Utilities	36,848	37,171	325
Government	111,907	112,585	678
Services	343,099	352,578	9,479
Other	211	213	2
Total[1]	752,794	773,514	-20,720

	New England County Metropolitan Area		
Industry	**Baseline**	**Proposed Action**	**Impact of Proposed Action**
Manufacturing	397,452	398,602	1,150
Construction	114,629	115,153	524
Wholesale	210,684	211,333	649
Retail	456,173	459,404	3,231
Finance, Insurance, Real Estate	241,423	244,827	3,404
Transport, Utilities	96,979	97,342	363
Government	331,914	332,888	974
Services	1,073,040	1,080,502	7,462
Other	19,251	19,270	19
Total[1]	2,941,545	2,959,321	17,776

1. May not sum due to rounding of figures

Source: Cambridge Systematics calculations based on REMI Model

Whether or not some classes of travel time savings lead to additional spending in the economy, they still represent transportation user efficiency benefits. These benefits are traditionally expressed in terms of the value of time benefits. The value of time savings is itself dependent on many factors, including traffic volumes, vehicle fleet mix, vehicle occupancy, trip purpose, and local usage rates.

The forecasts of the study area traffic conditions in the year 2010 show a reduction of 152,000 vehicle hours of travel time per day due to completion of the Artery/Tunnel Project. Of this savings, car trips represent 139,000 vehicle hours per day, or 91 percent of the trips and travel time savings. Truck trips represent 13,000 vehicle hours per day, or 9 percent of the trips and travel time savings. Based on recent transportation studies of individual valuation of time, delays in automobile travel are valued at 60 percent of the average wage for drivers and 40 percent for passengers. Average vehicle occupancy was estimated at 1.41 persons, based on a weighted average of the various types of trips distinguished in the traffic analysis. The average 2010 wage was estimated relative to the national average from the REMI model. These factors yield a value of $10.78 per vehicle per hour (in 1987 dollars) for automobile travel. On an annual basis, the value of time saved in 2010 under the Proposed Action is estimated at $445 million for automobile travel when compared to the 2010 baseline.

Delays in truck travel time are valued at $24.28 per vehicle per hour, based on recent studies. This value includes the truck driver's wages and vehicle operating costs, excluding fuel. The annual value of trucking time saved in 2010 under the Proposed Action is estimated at $85 million, compared with the 2010 baseline. This benefit for truck travel time savings is considered to be a savings in business costs, which ultimately affects economic expansion. This impact also is addressed in Section 7.2.4.

Using commonly accepted measures of time valuation, discussed above, the overall travel delay reductions for car and truck trips represent a travel user benefit of approximately $530 million annually.

Of the travel delay reduction benefits for cars, approximately 40 percent ($178 million, or approximately $600 per worker per year) are associated with commuter trips to and from the study area. These benefits affect the study area economy through impacts on downtown business wages, as discussed in Section 7.2.2. Another 10 percent are nonwork trips to and from the study area, some of which affect retail and tourism patterns, as discussed in Sections 7.2.3 and 7.2.6. However, much of the travel delay reduction benefits for car travel are savings of individual time wasted, which are very real personal benefits, although they do not affect business sales or jobs.

The remaining 50 percent of the automobile travel delay reduction benefits accrue to longer-distance trips that pass through downtown Boston using the Central Artery or Harbor tunnels, although their origins and destinations are beyond the study area. The impacts of these savings to the region and the Nation were not further identified in this analysis.

The above estimates of time savings for travellers are underestimates of the total user benefits. There is no available estimate of the extent to which highway system users would travel extra distance and consume extra fuel in order to bypass the Boston area under 2010 baseline conditions, although such detours would occur as congestion increases.

While both cars and trucks will travel faster upon completion of the Artery/Tunnel Project, total vehicle miles of travel will not decrease, and savings in fuel consumption will be limited to that which arises from improved performance by the 2010 vehicle fleet and from higher travel speeds. Annual fuel savings are estimated in Chapter 6 and would have a 1987 dollar value of $16 to $23 million in 2010 with the project as compared to the 2010 baseline.

7.2.10 Fiscal Impacts

This section describes the fiscal impacts of the completed Artery/Tunnel Project on the finances of the State of Massachusetts in the year 2010, compared to the 2010 baseline. The estimates of changes in State revenues are a direct outcome of the forecast changes in business sales, personal income and tourism, provided earlier in this chapter. They assume continuation of currently applicable tax rates and fee schedules. The estimates of changes in State expenditures depend principally on the characteristics of financing the State share of project construction costs.

With the Proposed Action, the change in year 2010 State revenues is forecast to be $56.5 million (expressed in 1987 dollars), assuming current tax rates and forecast population and employment levels. State expenditures as a result of the project consist of debt service on the State share of the earlier construction costs, which the Department estimates will average $39.4 million per year (expressed in 1987 dollars), assuming 30-year 8 percent bonds. Total revenue after expenditures are therefore estimated to be $17.4 million (see Table 7.23). Since all of these figures are expressed in terms of constant 1987 dollars, the actual revenue and costs in the year 2010, as well as the size of the bond, will be larger to account for inflation. The nature of the findings, however, hold regardless of whether all figures are expressed in constant dollars or in inflated future dollars.

It is important to note that the revenues are sensitive to the tax rate. The validity of these revenue estimates is a function of the application of current rates and fees to forecast year 2010 levels of output, wages, and sales. The household income tax yield is based upon a forecast of $841 million in additional household income within the State, resulting from 17,800 additional jobs created. The Massachusetts Department of Revenue estimates that 73 percent of Massachusetts gross personal income is taxable. At current income tax rates (5 percent), this results in the forecast of $31 million in additional personal income tax revenue for the year 2010.

According to the Massachusetts Department of Revenue, the revenue from sales tax is based upon 15 percent of gross personal income expended on taxable retail purchases by individuals. Additional sales tax is generated by business purchases. The additional sales tax revenue is estimated to be $14 million in the year 2010. The corporate income tax is applied to net business income, which averages 0.64 percent of gross corporate receipts. This amount is taxed at a rate of 9.5 percent. Additional taxes are collected from banks, insurance companies, and public utilities based on other tax rates. The total additional tax revenue from business income taxes is estimated to be $1.7 million for the year 2010. Hotel room charges are taxed at a rate of 5.7 percent. This rate, applied to the projected charge in visitor spending on hotel room charges, yields additional hotel tax revenue of $2.1 million in the year 2010.

Table 7.23

LONG-TERM (YEAR 2010) ANNUAL FISCAL IMPACTS OF THE PROPOSED ACTION ON THE COMMONWEALTH OF MASSACHUSETTS
(all figures expressed in terms of constant 1987 dollars)

	Amount In Millions of Constant 1987 Dollars
REVENUES (average annual)	
Personal Income Tax	30.8
Sales Tax	14.2
Business Taxes	1.7
Other Taxes and Fees	7.7
Total	56.5
EXPENDITURES	
Debt Service	39.1
Total	39.1
EXCESS OF REVENUES OVER EXPENDITURES[2]	17.4

1. Debt service estimates are from the Department of Public Works
2. Revenues and expenditures are derived from the Cambridge Systematics Fiscal Impact Model. Revenues are based on current (FY 1988) rates and schedules. See text for details.

Sources: Cambridge Systematics, Inc.
Massachusetts Department of Revenue
Massachusetts Executive Office of Administration and Finance
Massachusetts Executive Office of Transportation and Construction

Other State revenues include motor fuel taxes, cigarette taxes, alcoholic beverage taxes, racing taxes, motor vehicle registration fees, deeds stamps, and estate taxes. The projection of these additional revenues is based upon a ratio of these revenues to the three principal revenues (personal income, sales, and corporate income) discussed above. These other revenue sources are estimated to provide an additional $7.7 million in State receipts in the year 2010.

Expenditure forecasts are based on borrowing the State share of project costs (including both "hard" and "soft" costs) at 8 percent interest for 30 years. The rate and form for the borrowing are those prevailing today for similar tax-exempt general obligation issues.

The average annual State revenues from income, sales, and other taxes generated by the long-term employment growth made possible by the project will exceed the anticipated State expenditures for debt secured during the year 2010 post-completion period.

7.3 MITIGATION MEASURES

The long-term economic impacts of the Artery/Tunnel Project are positive, as there are essentially no negative impacts except for requirements to meet needs created by new economic growth. In addition, once completed, the project represents a relatively fixed resource that would be difficult and expensive to enlarge, and a variety of measures should be implemented in the long term to maximize and maintain the value of this transportation resource in an era of continued population growth.

The public transit service improvements described in Section 5.1 along with promotional programs that increase the transit share of total trips can provide for a substantial part of future growth without impacting the road system. Improved traffic management and transportation information programs, which could grow out of construction mitigation programs, can reduce bottlenecks and congestion through rerouting to make the best use of available capacity. Measures that reduce peak period traffic volumes, such as flextime and preferential parking for high-occupancy vehicles, will be necessary to limit future increases in commuter time and consequent wage effects.

A related issue will be the increased demand for parking that results from long-term growth in population and employment. Programs will be required to preserve a suitable supply of short-term parking to avoid an impact on retail sales and to allow tourists and business and convention visitors to use and enjoy the City. Remote parking and pick-up provisions for tour buses will be required to make up for lost space under the elevated Artery and to provide for growing volumes of tourists.

In addition, programs that preserve and promote affordable housing in the study area will be necessary to maintain social diversity among the residents, because the improvements in urban quality resulting from the Artery/Tunnel Project will put upward pressure on house prices and rents.

7.4 COMPARISON WITH FEIS/R

The conclusions regarding the long-term economic impacts of the Proposed Action are consistent with the general enhancement of economic conditions for the region and the study as reported in the 1985 FEIS/R. Additional detail, reported in this section, has been developed in the course of the SEIS/R analysis to support and to attempt to quantify the overall conclusions of the FEIS/R regarding long-term impacts. (Comparison with construction period impacts is made in Chapter 20.)

The FEIS/R reported a time savings of approximately 17 million person hours per year as a result of the Preferred Alternative when compared to a 2010 base case forecast from existing conditions at the time of the FEIS/R. The SEIS/R analysis shows a much larger time savings of approximately 60 million person hours per year. Reasons for this difference include the fact that the SEIS/R forecast of the 2010 baseline anticipates much higher levels of congestion, based on measured changes in traffic since the FEIS/R. The improvement from this more congested 2010 baseline is a substantial part of the difference. The various alignment improvements described in Chapter 2 further contribute to the greater time savings forecast in the SEIS/R. The result is that the Proposed Action is expected to be more beneficial with respect to the 2010 baseline than was the case for the Preferred Alternative of the FEIS/R.

7.5 RESOLUTION OF ISSUES RAISED BY AGENCIES

Issues raised by the City of Boston, primarily the Boston Redevelopment Authority, and the Metropolitan Area Planning Council regarding long-range forecasts data and geographic areas used have been resolved through consultation with them. This chapter reflects the results of these consultations.

Chapter 8 – Land Use and Neighborhood Characteristics

Chapter 8

LAND USE AND NEIGHBORHOOD CHARACTERISTICS

This chapter reviews changes that have occurred in land use and neighborhood characteristics in each subarea since the FEIS/R (Section 8.1), and describes potential impacts because of the Proposed Action (Section 8.2). Growth and new development in various subareas have added to existing traffic and thus increase the need for the Proposed Action. The Proposed Action will provide improvements in both access and the visual environment that support and reinforce ongoing development activities, but general land use patterns will not change. Since the alignment of the Proposed Action and its tunnel, structure, and at-grade elements are similar to what was described in the FEIS/R, the land use impacts in most subareas will not be substantially different from those described in that document (see Section 8.4) except at the immediate site of the road corridor and associated buildings for ventilation, operations, and maintenance. None of the changes, however, will alter the general land use pattern of the area.

Alignment modifications have been made to improve opportunities for positive land use changes. The long-term impact of the Proposed Action on neighborhoods and community facilities is generally expected to be beneficial, providing opportunities for the expansion of the North End, Chinatown, and East Boston subareas, and a reduction of "short-cut" traffic in all neighborhoods. For example, the Proposed Action will have the following specific benefits: more opportunities in the Central Area for joint development and for better pedestrian and vehicular connections due to design changes; reduced impacts to the Fort Point Channel and new development parcels near Chinatown due to alignment changes; reduced truck traffic on local streets, particularly in South Boston; and park expansion opportunities at East Boston Memorial Stadium Park and along the Charles River (see Section 8.2.1, Land Use Impact Overview).

8.1 AFFECTED ENVIRONMENT

In general, the overall land use pattern has not changed in the project area since the FEIS/R. However, the density of development has increased substantially, primarily in the Central Area, due to new office/retail projects. Floor space for such uses completed since 1983, or currently under construction, totals over 3 million square feet in the I-93/I-90 Interchange and Massachusetts Avenue Interchange Area, and 9 million square feet in the Central Area. Planned and/or approved developments are expected to increase floor space further by over 1 million square feet in these subareas.

Downtown residential development also has increased rapidly in recent years. Since 1983, approximately 1,300 new dwelling units have been constructed, and another 470 are planned. (Residential development in all subareas consists of rental or condominium apartments, rather than detached single-family houses.)

Since the FEIS/R, the City of Boston has instituted new planning and development controls in the Artery/Tunnel Project area. For example, four of the six project subareas are within

the boundaries of the new Downtown Boston Interim Planning Overlay District (IPOD) administered by the Boston Redevelopment Authority (BRA) since September 1987. The Downtown IPOD places temporary development controls on certain neighborhoods while permanent zoning changes are being defined and implemented. The main goals of this effort include establishing height, bulk, and use limitations, protecting historic structures and open space, and instituting an environmental review process and traffic management plans.

The Central Artery right-of-way is a separate Special Study Area. The IPOD states that planning and rezoning initiatives by the City of Boston in the Central Artery area will promote provision of replacement parking in the Financial District and Bulfinch Triangle, affordable housing in the North End, and enhanced views and open space in the Waterfront area. (The Joint Development Appendix contains a more detailed description of the IPOD process.)

Most of the neighborhoods which border on or lie within the project area have their own dominant ethnic population (Irish, Italian, or Asian) and physical character. Despite the differences in the City's neighborhoods, increased development activity has put pressure on all of them. Short-cut travel patterns, construction detours, increased parking demand, and escalating housing costs have all been identified as neighborhood issues associated with the new development. Although the issues are not new to the neighborhoods, heightened awareness and concern have prompted the City to help establish neighborhood councils, providing for a new, more formalized review process for new BRA development projects. A description of the major changes in land use and neighborhood characteristics is provided below for each of the project subareas.

8.1.1 Area North Of Causeway Street

North Station. The North Station area also includes the immediate area south of Causeway Street because the land use activities are associated more with the North Station area than the Central Area of the project. The rehabilitation of buildings in the Bulfinch Triangle for office space is increasing, and a few new office buildings have been completed or are under construction (see Table 8.1 and Figures 8.1 and 8.2). A new Boston Garden arena, an underground parking garage, an additional commercial development, and new regional transit and commuter rail facilities are planned at North Station. Additional public open space along the Charles River linking the Leverett Circle area to the walkway by Spaulding Rehabilitation Hospital is planned by the Metropolitan District Commission (MDC).

The goal for the North Station area, as stated in the IPOD regulations, is to encourage mixed use development compatible with the adjacent Bulfinch Triangle and North End districts.

Charlestown. The Charlestown Navy Yard continues to be redeveloped for residential and office use, and is expected to encourage further development in the surrounding area (see Table 8.1 and Figures 8.1 through 8.3). Plans are underway for relocation of the New England Aquarium to a new facility at the Navy Yard.

The Central Artery North Area (CANA) Project (highway) now under construction is expected to stimulate new development on new parcels it will create near City Square and rehabilitation

Table 8.1

MAJOR LAND USE CHANGES SINCE 1983 IN AREA NORTH OF CAUSEWAY STREET

Project	Size	Use	Status	Completion Date
North Station				
1. GSA Federal Building	650,000 sf	office	complete	1985
2. 101 Merrimac Street	155,000 sf	office	under construction	(1990)
3. Suffolk County Jail	200,000 sf	jail	under construction	(1990)
4. Arena Complex	18,000 seats	arena	planning stage	1993/94
	1.3 million sf	office		
	63,000 sf	hotel		
	70,000 sf	retail		
	2.3 million sf	total		
5. 100 Portland Place	100,000 sf	rehab	under construction	1990
Charlestown				
1. Charlestown Navy Yard	1,134,000 sf		completed to date	--
(includes conversion	733 units	residential		
of abandoned	2,035 spaces	parking		
buildings)	2,500,000 sf			
	1,800 units	residential		
	4,000 spaces	parking		
2. Aquarium	N/A	aquarium	planning stage	unknown
Cambridge				
1. New Lechmere Station	N/A	public transit	in design	(1992)
2. 17 O'Brien Hwy.[3]	19,000 sf add.	office	approvals process	(1991)
3. 15 O'Brien Hwy.[3]				
Phase I	435 units	rental housing	approvals process	(1991)
Phase II	205 rooms	hotel		(1991)
4. MDC Riverfront Park (portion is in Boston)	N/A	open space	planning stage	unknown
West End				
1. Wellman Building	136,000 sf	hospital/ research	complete	1984
2. Bartlett Extension	40,000 sf	office/ research	complete	1987
3. Professional Office Building	44,000 sf	office	complete	1989
4. Tower 1	389,000 sf	hospital	under construction	(1990)
Tower 2	290,000 sf	hospital	planning stage	(1993)

1. N/A: Not available
2. Parcel locations shown on Figures 8.1 and 8.2
3. North Point development area

Sources: Boston Redevelopment Authority
Cambridge Redevelopment Authority

of existing buildings in the area. The CANA EIS designated five development parcels in City Square. During the past few years, the neighborhood has experienced a marked increase in housing rehabilitation and condominium construction.

Charlestown has attracted many new, young, well educated residents in the last 10 years. The 1985 population (14,115 people), was up approximately 6 percent from 1980. While over 50 percent of the population has lived in the neighborhood for 5 years or less, the neighborhood is still considered a traditional family neighborhood. Charlestown has a higher proportion of more traditional families and older couples, and fewer single parent families, than the average for the City as a whole.

The changing real estate market in Charlestown reflects the new attractiveness of living in the neighborhood. According to a BRA survey, housing values have nearly quadrupled in the last 5 years (from $36,000 to $140,000), rising from values comparable to the 1979 City average to those well above it in 1985. The condominium market, particularly, has grown.

Building upon the North Area Task Force, which has been working as a neighborhood group for more than a decade and was initiated as a result of the CANA project, the City helped Charlestown residents to form the Charlestown Neighborhood Council 2 years ago. Parking and the lack of accessibility to the public transportation have been identified as particular concerns for the Charlestown community.

Cambridge. The North Point area of Cambridge (not affected by the Preferred Alternative in the FEIS/R, and, therefore, not described in that document) is bounded by the Charles River on the south, O'Brien Highway on the west, Somerville to the northwest, and Millers River and Boston (Charlestown) to the northeast. The area comprises primarily industrial, public infrastructure, and transportation uses, including the Massachusetts Water Resources Authority Prison Point Pumping Station, railroad tracks and piggyback yards owned by Guilford Transportation Industries, an MDC maintenance facility, a Massachusetts Department of Public Works storage area, and a solid waste transfer station. The area recently has been the focus of a great deal of planning activity by the Cambridge Community Development Department. Plans for the area include redevelopment for mixed residential/commercial use, with an emphasis on housing (see Table 8.1 and Figure 8.2). Planned public projects include development of a new riverfront park by the MDC. A future new, relocated MBTA Green Line Lechmere station will serve the area.

West End. Recent development in the area includes substantial additions to Massachusetts General Hospital (see Table 8.1 and Figures 8.2 and 8.3). Undeveloped land in the area is limited to the remaining urban renewal parcel at Charles River Park (housing development).

8.1.2 Central Area

North End. Although the housing stock once consisted mainly of rental units, there are now many new and converted condominium apartments in the area. The construction of housing for the elderly and the conversion of old warehouse buildings to housing have increased the number of units. Some low-rise, high-rent office space has recently been developed on the east edge of the North End, an area that has become an extension of the Waterfront district and its high-priced office/residential/retail orientation (see Table 8.2 and Figures 8.2 and 8.4). Most projects in the North End have been conversions/rehabilitations rather than new construction.

Note: See Tables 8.1 through 8.5 for number designations

FIGURE 8.1

Major Land Use Changes Since 1983 - Project Area

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

FIGURE

8.2

Major Land Use Changes Since 1983 - Downtown

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R


North Station: New Federal Office Building and 100 Portland Place.


North Station: New Suffolk County Jail with Central Artery ramps in background.


North Station: Rehabilitated Commonwealth Brewery in Bulfinch Triangle.


Charlestown: Renovated buildings in City Square.


Charlestown: Charlestown Navy Yard.


West End: Massachusetts General Hospital with Wang Ambulatory Center to the right and new hospital addition on left.

FIGURE 8.3

Area North Of Causeway Street

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

North End: Recent residential rehabs.

Waterfront: Marketplace Center.

North End: 585 Commercial Street under construction on North End waterfront.

Waterfront: Rowes Wharf.

FIGURE 8.4

Central Area

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

Table 8.2

MAJOR LAND USE CHANGES SINCE 1983 IN CENTRAL AREA

Project	Size	Use	Status	Completion Date
North End				
1. 350 North Street	37 units	residential	complete	1986
2. The Mariner	105 units	residential	complete	1986
3. North End Community Health Center	69,000 sf	medical	complete	1984
4. Fulton Court	65 units	residential	complete	1989
Waterfront/Market Area				
1. Marketplace Center	500,000 sf	office/retail	complete	1986
2. One Faneuil Hall Square	41,000 sf	retail	complete	1989
3. Rowes Wharf	665,000 sf	hotel/office/ condominium	complete	1988
4. Rose Kennedy Rose Garden	N/A	park	complete	1987
5. Long Wharf	N/A	park/ferry terminal	park complete	(1990) 1989
6. Lewis Wharf	200,000 sf	hotel	planning stage	N/A
7. Sargent's Wharf	310,000 sf	residential/ commercial	planning stage	unknown
8. Lincoln Wharf	117,000 sf 2,400 sf	residential fire boat station	planning stage	N/A
9. Central Wharf[1]	N/A	mixed	planning stage	N/A

Table 8.2 (Cont.)

MAJOR LAND USE CHANGES SINCE 1983 IN CENTRAL AREA

Project	Size	Use	Status	Completio[n] Date
Government Center				
1. 15 New Chardon Street	140,000 sf	office	complete	1989
2. Government Center Garage	250,000 sf	office	under construction	(1990)
Financial District				
1. International Place I	837,000 sf	office/retail	complete	1986
2. 101 Federal Street	565,000 sf	office	complete	1988
3. 150 Federal Street	537,000 sf	office	complete	1988
4. 155 Federal Street	200,000 sf	office	complete	1984
5. 75 State Street	715,000 sf	office	complete	1988
6. 101 Arch Street	422,000 sf	office/retail	complete	1989
7. 20 & 21 Custom House Street	235,000 sf	office	complete	1989
8. 125 High Street	1,385,000 sf	office/retail	under construction	(1990)[4]
9. Post Office Square	1,400 spaces	parking/park	under construction	(1990)[5]
10. 99 Summer Street	220,000 sf	office	complete	1987
11. 125 Summer Street	448,000 sf	office/parking	complete	1989
12. International Place II	600,000 sf	office	under construction	(1992)

1. Present site of New England Aquarium
2. N/A: Not available
3. Parcel locations shown on Figure 8.2
4. First tower complete
5. Park 1991

Source: Boston Redevelopment Authority and Bechtel/Parsons Brinckerhoff

Housing demand is strong, with the number of rental units declining as a result of many condominium conversions. According to a 1985 BRA survey, conversions have affected roughly one-fifth of the total housing stock in the North End, with unit prices and rental rates being high relative to other neighborhoods.

Recent development activity has raised concerns about density and parking in the neighborhood and has given rise to the creation of the North End/Waterfront Neighborhood Council.

Waterfront/Market Area. New development has been primarily for commercial uses in the area adjacent to Faneuil Hall (see Table 8.2 and Figures 8.2 and 8.4). Wharves east of Atlantic Avenue and north of Long Wharf are occupied by mixed commercial/residential uses, much of which has been built or renovated/converted during the past 10 years.

Christopher Columbus Park on the waterfront, which includes the recently opened Rose Kennedy Rose Garden, is the neighborhood's major public park. North End and waterfront residents share it with thousands of visitors to Boston and other City dwellers. In addition, Long Wharf Park was opened in 1989.

Some new residential development has occurred on the waterfront; most notable is the Rowes Wharf complex which includes some of the City's most expensive condominium apartments and a popular waterside open space. A major commuter ferry and airport water shuttle terminal is located at Rowes Wharf, serving hundreds of passengers daily.

A new neighborhood council, referred to above in the North End section, with members from both the Waterfront and North End neighborhoods, is active with respect to development issues in the area. Interim zoning amendments were adopted recently, initiating review of and possible revisions to the permanent zoning controls.

Phase I of the BRA Harborpark project involves the creation of a walkway along the Inner Harbor's edge from Little Mystic Channel in Charlestown to Fort Point Channel. The walkway, as proposed, will include a number of water-related recreational facilities. The project has been divided into nine districts for which the BRA is developing individual conceptual plans and design standards. Overall completion of the project is scheduled to coincide with the Central Artery project, as certain areas of the walkway will be designed to connect with at-grade open space resulting from the placement of the Central Artery underground.

Government Center. Recent development in the area has been limited to renovations and additions due to the lack of available parcels (see Table 8.2 and Figures 8.2 and 8.5).

Financial District. Recent development in the Financial District, including eight new buildings with a total of 3,731,000 square feet, has increased density substantially, with a consequent increase in pedestrian and vehicular activity (see Table 8.2 and Figures 8.2 and 8.5).

Fort Point Channel. Since the FEIS/R was written, the perception of the Fort Point Channel district boundaries has changed to include land on both sides of the Channel (the FEIS/R defined the district as only that area on the west side of the Channel). This area contains a mix of land uses and is changing from primarily industrial uses to a mix of office/commercial, residential and industrial uses (see Figure 8.5).

There is a strong interest in developing public access and open space around the Channel and connecting these areas to existing walkways, for which several plans have been developed including the BRA's Harborpark. The Harbor Rowing Club opened in 1987 on a barge along the Congress Street bridge.

Development of the South Boston IPOD, which will include the east side of Fort Point Channel, is not yet complete. One of the goals of this IPOD will be to create a mixed use area with increased parking near major highway exits and an improved pedestrian environment in the South Station area.

Project plans for the area include the Northern Avenue bridge relocation project, on which construction began in late 1989.

8.1.3 I-93/I-90 Interchange And Massachusetts Avenue Interchange Area

Chinatown/South Cove. The Chinatown neighborhood has expanded south across the Massachusetts Turnpike to the South End since the FEIS/R. The redevelopment of the Kingston/Bedford parking garage site into 1,000,000 square feet of office and retail space, scheduled for completion in 1992, will represent a major shift in land use on this block (see Table 8.3 and Figures 8.2 and 8.6).

Expansion of commercial and institutional uses has placed pressure on the housing stock as the residential population continues to grow. Asian businesses are expanding to Washington Street from the east. Growth of medical institutions, in particular, has been continuing, and the new Midtown Cultural District to the west will be the locus of further development pressure.

Development of new housing units has not kept pace with the increase in residents. This has resulted, in many cases, in more than one family occupying a single residential unit. Chinatown is now within a Residential Priority Zone, where 50 to 75 percent of new developments must be devoted to residential use.

Potential for increased traffic is of particular concern to Chinatown residents. The Chinatown Neighborhood Council was established to monitor and review development in the district. The location of housing (such as Tai Tung Village, Mass Pike Towers, and Castle Square) and the Quincy School in close proximity to busy roads, such as Marginal Road, has raised concern about potential increases in traffic on these streets. Existing short-cut travel patterns through the neighborhood already detract from the quality of life, particularly on Harrison Avenue and Hudson Street.

Leather District. Land use in the area is changing from the traditional leather and garment-oriented firms to a variety of new design and graphic arts businesses, housing, and galleries for which the existing loft space is most suitable. In addition, the district's proximity to downtown Boston has attracted office uses and retail services associated with the Financial District (see Table 8.3 and Figures 8.2 and 8.7).

South End. The area has been experiencing active development, especially residential. Renovation of old, and in some cases abandoned, houses has been very active, and the market for condominiums has been strong. Renovated units command high prices. New

Government Center: Government Center Garage undergoing expansion.

Financial District: View across mouth of Fort Point Channel to Boston Waterfront and International Place.

Financial District: 20 Custom House Street.

Financial District: 125 High Street under construction with International Place in background.

Financial District: View of 101, 150 and 155 Federal Street.

Financial District: 125 Summer Street under construction with 99 Summer Street in background.

FIGURE 8.5

Central Area

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

Restaurants and shops along Beach Street.


Rehabilitated China Trade Center on Boylston Street.


View of Chinatown Gate at Beach Street.


New Tufts University Sackler Center.

FIGURE 8.6

Chinatown/South Cove

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

Leather District: Recently renovated Blue Diner.

Leather District: Recent renovations on South Street.

Leather District: 745 Atlantic Avenue.

Recently renovated South Station Transportation Center with Red Line transportation improvements under construction.

South End: Renovations to Rotch Playground.

FIGURE 8.7

I-93/I-90 Interchange And Massachusetts Avenue Interchange Area

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

Table 8.3

MAJOR LAND USE CHANGES SINCE 1983 IN I-93/I-90 INTERCHANGE AND MASSACHUSETTS AVENUE INTERCHANGE AREA

Project	Size	Use	Status	Completion Date
Chinatown/South Cove				
1. Tufts/New England Medical Center Library	200,000 sf	medical education	complete	1984
2. Sackler Center	134,875 sf	medical research	complete	1984
3. South Cove Nursing Home	100 beds	medical	complete	1985
4. Oxford Place	39 units	residential	complete	1984
5. Kingston/Bedford	1,000,000 sf	office/retail	planning stage	(1992)
Leather District				
1. One Financial Center	1,108,000 sf	office	complete	1984
2. 745 Atlantic Avenue	174,000 sf	office	complete	1989
3. Wang Corporation	100,000 sf	office	complete	1986
4. South Station Transportation Center I	250,000 sf	transportation	complete	1989
	125,000 sf	office/retail	complete	1989
5. South Station Transportation Center II	1,000,000 sf	bus terminal/ 550 parking spaces	planning stage	(1992)
South Bay/Newmarket				
1. Suffolk County House of Correction	N/A	institutional	under construction	(1992)
South End				
1. New England Nuclear	60,000 sf	industrial	complete	1985
2. South End Technology Square Associates (SETSA) I	150,000 sf	office	under construction	1989
3. SETSA II	535,000 sf	office	planning stage	unknown
23,000 sf	retail			
250 rooms	hotel			
180 seats	restaurant			
700-900 spaces	parking			

1. Parcel locations shown on Figures 8.1 and 8.2
2. N/A: Not available

Source: Boston Redevelopment Authority

retail and personal service establishments have been locating along Washington Street, Columbus Avenue, and Tremont Street, catering to occupants of the new residential developments. New construction has been primarily in the industrial area east of Harrison Avenue, closer to the Southeast Expressway (see Table 8.3 and Figures 8.1 and 8.7). It is primarily this industrial area which is within the project area.

The population increase experienced in the late 1970s reversed in the early 1980s. The decline is largely a result of the trend toward smaller households. The housing unit vacancy rate dropped sharply, continuing its decline from 12 percent in 1980 to 3 percent in 1985. The total number of housing units increased by approximately 140, while renovation of substandard units added 375. Condominium conversion of rental apartments and/or vacant space has been occurring at a rapid pace, with over 1,100 units converted or developed since 1980. This conversion activity has resulted in a change in the socioeconomic make-up of the neighborhood; median household income has nearly doubled since 1980. Housing costs have increased substantially. The average home value was $320,000 in 1985 (up from approximately $67,000 in 1980), with 1985 rents averaging about $370 per month (up from approximately $185).

The South End has not established a neighborhood council, opting instead for a "town meeting" approach whereby issue-oriented, at-large meetings are held. The forums have led to a neighborhood rezoning effort and the South End Neighborhood Housing Initiative, which will create some 625 units of mixed-income housing.

South Bay/Newmarket. The City of Boston's Economic Development and Industrial Corporation (EDIC) completed a revitalization plan for the Newmarket Industrial District in January 1988. The plan seeks to create an attractive light manufacturing district buffered from adjacent residential neighborhoods by areas of landscaping and transitional zones with facilities for day care, job training, and service uses such as cafes and convenience stores. Implementation of the plan, which involves $116.3 million of public investment for physical improvements, site acquisition, and business assistance, has not yet begun. Other potential public investment in the area includes the Suffolk County House of Correction (see Table 8.3 and Figure 8.1).

8.1.4 South Boston And South Boston Bypass Road Area

Recent development in the area has consisted primarily of renovations and/or rehabilitation of existing industrial buildings for office uses (see Table 8.4 and Figures 8.1 and 8.8). A new police station was completed in 1989 near West Broadway and A Street. Some new infill housing has been recently built, and rehabilitation of the West Broadway Development (public housing) continues.

According to the BRA's 1985 survey, there has been less change in South Boston in the past decade than in other neighborhoods close to downtown Boston. The 1985 population was roughly the same as in 1980 (30,079 in 1985 compared to 30,372 in 1980). Increased housing demand has resulted in a decline in the vacancy rate between 1980 and 1985. Housing prices rose, but the average house value of $100,000 was still below the average 1985 Boston house value of $115,000. There was a net housing unit increase (including both new construction and conversions of old factories to condominium apartments) of approximately 240 units. Rental units continue to make up about 75 percent of the total housing inventory. According to the BRA, South Boston has become a neighborhood of poorer, older residents. The

Boston Design Center in newly rehabilitated building at former Army Base.

Newly rehabilitated Fish Pier.

Coastal Cement Building.

Newly rehabilitated D Street housing.

Fort Point Channel: View across Congress Street Bridge and Channel to recently renovated 303 Congress Street.

New housing on Bolton Street near South Boston Bypass Road.

FIGURE 8.8

South Boston

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SUPPLEMENTAL EIS/R

Table 8.4

MAJOR LAND USE CHANGES SINCE 1983 IN SOUTH BOSTON AND SOUTH BOSTON BYPASS ROAD AREA

Project	Size	Use	Status	Completion Date
1. World Trade Center I	550,000 sf 120,000 sf 400 seats	office exhibition theatre/ meeting space	complete	1986
2. Coastal Cement Corp.	81,000 sf	industrial	complete	1988
3. Design Center/ Building 114	900,000 sf 1,100 spaces 7,000 sf	office parking restaurant/ seminar space	complete	1985
4. Fish Pier	259,000 sf	industrial	complete	1985
5. 435 Summer Street	180,000 sf	office	under construction	(1989)
6. World Trade Center II	1.7-2 million sf	mixed use	planning stage	(1992)
7. Police Station	N/A	government	complete	1989
8. The Foundry	52 units	residential	complete	1989
9. New Pier 10 Park (Dry Dock #3)	N/A	park	complete	1989
10. New Battleship Park (Dry Dock #3)	0.5 acre	park	complete	1989
11. Flaherty Park (reconstruction)	0.3 acre	park	complete	1988

1. Parcel locations shown on Figure 8.1
2. N/A: Not available

Source: Boston Redevelopment Authority and Bechtel/Parsons Brinckerhoff

neighborhood's poverty rate (31 percent in 1984) was considerably higher than for the City as a whole (21 percent). The 1984 figure for South Boston represented an 11 percent increase over 1979; the poverty rate in Boston as a whole grew by only 1 percent over the same period.

South Boston is as much a cohesive neighborhood today as it has ever been. Two of the oldest neighborhood groups in the City are based in South Boston: the South Boston Residents' Group and the South Boston Citizens Association. Representing these older neighborhood groups as well as the many other South Boston neighborhood associations (for example, St. Vincent's Parish) is the role of the new Fort Point Channel Citizens Advisory Committee. This organization reviews development proposals. The South Boston Transportation Advisory Committee (TAC), focuses on traffic issues. It is concerned that detours during the Central Artery construction will result in permanent commuter travel patterns through the neighborhood, as was the case with the recent Southeast Expressway (I-93) reconstruction.

8.1.5 East Boston/Logan Airport Area

East Boston. Massport Piers 3 and 4 are planned for use as a park, and Pier 5 is planned for a lobster fishing terminal. A feasibility study concerning potential uses for Piers 1 and 2 is underway also (see Table 8.5 and Figures 8.1 and 8.9). The East Boston IPOD, adopted in June 1988, includes height limits and increased parking ratios. Development of airport-related uses outside of the boundaries of Logan Airport will be limited. The variance/conditional use permit system in industrially-zoned land will be determined by the IPOD process. The East Boston waterfront is a Special Study Area. No major land use changes have occurred in the Route 1A North area since 1983 near the project limits.

Total 1985 population was 32,956, up only slightly from 32,178 in 1980. East Boston's relatively lower housing costs and convenient access to Boston have attracted new residents including many Asians. Housing values and rents remain below the City average despite an increase in housing demand since 1980. The average value of a house in East Boston in 1985 was $87,000, compared to $115,000 in Boston as a whole.

The East Boston community is represented by a variety of neighborhood groups. Most of these organizations have existed for some time, and have established themselves as strong voices. In 1986, a new group was formed to unite and represent the different groups. The purpose of this group, the East Boston Planning and Zoning Advisory Committee, is to embark on a comprehensive review of the current zoning and to make recommendations for revised final zoning to the BRA and the Zoning Commission.

Logan Airport. Bird Island Flats is the terminus for Massport's new Airport Water Shuttle ferry service to downtown Boston (Rowes Wharf) where a new office development was opened in 1985. In addition, new air cargo and general aviation facilities, totalling 308,000 square feet, were constructed at Bird Island Flats in 1986 (see Table 8.5 and Figures 8.1 and 8.9). Air passenger traffic increased 30 percent between 1983 and 1987, while air cargo tonnage increased by over 18 percent. This airport activity has been and will continue to be a stimulus for future land use development.

Table 8.5

MAJOR LAND USE CHANGES SINCE 1983 IN
EAST BOSTON/LOGAN AIRPORT AREA

Project[1]	Size	Use	Status	Completion Date
East Boston				
1. Leverett Avenue Condominiums	36 units	residential	complete	1983
2. Neptune Circle	25 units	residential	complete	1985
3. Gumball Factory				
Conversion	49 units	residential	under construction	(1990)
Addition	40 units	residential	under construction	(1990)
4. Clippership Wharf	370 units	residential	planning stage	(1991)
5. Lobstermen's Terminal/Park	N/A	commercial fishing/park	planning stage	N/A
6. Ramada Inn addition	120 rooms	hotel	under construction	(1992)
Logan Airport				
1. Mass Tech Center I 300 spaces	177,768 sf parking	office	complete	1985
2. NW Cargo	68,000 sf	transport	complete	1986
3. Air Cargo	220,000 sf	transport	complete	1986
4. General Aviation	20,000 sf	transport	complete	1986
5. Ferry Terminal	N/A	transport	complete	1985
6. Mass Tech Center II	750,000 sf 220,000 sf 1100 spaces	office hotel parking	planning stage	(1995)

1. Parcel locations shown on Figure 8.1
2. N/A: Not available

Source: Boston Redevelopment Authority

opposed developments will be located primarily in the Bird Island Flats area and in the North Service Area.

8.2 ENVIRONMENTAL CONSEQUENCES/LAND USE IMPACTS

This section describes the impacts of the Proposed Action on land use and neighborhood and community facilities. Impacts on land use, neighborhoods, and community facilities are discussed in detail for each of the project subareas, along with a comparison of impacts with those described in the FEIS/R.

A proposed process for joint development planning is described in detail in the Appendix on Joint Development. Business relocations as a result of the Proposed Action and the process and plan for relocating businesses are described in detail in the Conceptual Relocation Plan Appendix. No residential displacements will be necessary.

8.2.1 Land Use Impact Overview

The Proposed Action had been designed to support and reinforce ongoing development activity; consequently, general land use patterns will not change because of the project. Since the alignment of the Proposed Action and its tunnel, structural and at-grade elements are similar to what was described in the FEIS/R, the land use impacts in most subareas will not be substantially different from those described in that document. The most apparent differences are expected in the Area North of Causeway Street, because of the redesign of the interchange. Alignment modifications throughout the corridor will generally create new opportunities for positive land use changes.

Major changes in the project design since the FEIS/R include the following:

- o The number of ramps in open boat sections in the Central Area will be decreased, providing more opportunities for joint development and improving pedestrian and vehicular connections between adjacent areas.

- o The relocation of the northbound segment of the Central Artery from along Fort Point Channel to under Atlantic Avenue, and the redesign of the I-93/I-90 Interchange, will reduce impacts to Fort Point Channel and will create new development parcels adjacent to Chinatown.

- o The inclusion of the South Boston Bypass Road as a part of the project will reduce truck traffic on local streets and, in conjunction with the Seaport Access Road, will support development plans for northern South Boston including seaport activities.

- o Alignment modifications in East Boston will allow for the expansion of East Boston Memorial Stadium Park and for the substantial improvement of connections between the park and the community.

- o The realignment in the Area North of Causeway Street will reduce impacts to the south bank of the Charles River and provide for the expansion of Paul Revere Landing Park on the north bank as well as for pedestrian connections from the south bank to City

Daniel Webster School, recently converted to condominiums.

Massachusetts Technology Center at Bird Island Flats.

General Aviation Building at Logan Airport.

New Northwest Cargo Building at Bird Island Flats.

FIGURE 8.9

East Boston/Logan Airport

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SUPPLEMENTAL EIS/R

Square. However, increased right-of-way will be required for the new ramps and bridges on the north side in the industrial area adjacent to the proposed North Point development. New pedestrian links are proposed along the river bank in Cambridge connecting the proposed North Point development and the Esplanade to the expanded Paul Revere Landing Park and City Square in Charlestown.

8.2.2 Neighborhood Impact Overview

In general, neighborhoods will continue to function much as they do today. The long-term impact of the Proposed Action on neighborhoods and community facilities is generally expected to be beneficial. In addition to removal of the elevated Central Artery barrier between the waterfront and North End and downtown, the improved transportation network for through traffic is expected to reduce short-cut travel patterns through residential neighborhoods as traffic shifts from local streets to the mainline Central Artery.

The Proposed Action will result in opportunities for expansion of the North End, Chinatown, and East Boston neighborhoods, and reduction in truck traffic. Improvements to local street patterns to serve the project will also benefit the neighborhoods.

8.2.3 Joint Development Overview

The placement of the Central Artery underground will create joint development opportunities throughout the alignment, including approximately 27 acres of developable land in air rights above the tunnel and adjacent to the tunnel in downtown Boston, and many developable parcels elsewhere.

Joint development opportunities (that is, possibilities for physical development in space under, over, or adjacent to the alignment for nontransportation purposes) have been the subject of considerable interest and discussion for some time, as has the joint development process itself. The process will be a decade-long cooperative effort among all the parties who will plan and carry out the development in space created by or affected by this project. Joint development opportunities and the process are described in detail in the Joint Development Appendix. The joint development process consists of three frameworks: participatory, regulatory, and physical.

Impacts of the future joint development projects will be determined by the environmental documentation required for the individual projects. The range of the development will be determined by the joint development process; therefore, potential impacts cannot be evaluated at this time.

8.2.4 Relocation

The Artery/Tunnel Project will require a number of relocations of operating businesses from the project right-of-way. The project will not result in any residential relocations. Many properties acquired for this project will not involve displacement (these are indicated on the tables in the project subarea descriptions in Section 8.2.8).

The FEIS/R indicated a total of 131 businesses employing 4,400 persons would be relocated as a result of the project. The Proposed Action will displace 134 businesses employing

approximately 4,100 persons. (These figures may change as a result of further refinements to the project design.)

A detailed explanation of all anticipated relocation impacts and the process for relocation is contained in the Conceptual Relocation Report Appendix.

8.2.5 Consistency Of Proposed Action With Local Plans

With the exception of parcel-specific land use impacts, the major changes in land use will result from joint development activities which will occur following construction of the Proposed Action but which are not part of the Proposed Action. As a result of the involvement of the cities of Boston and Cambridge in the joint development process, development of parcels created by the Proposed Action will be consistent with the general plans for the cities of Boston and Cambridge and with other locally determined land use and planning goals.

8.2.6 Regional Land Use Impacts

Long-Term. Long-term regional impacts of the Artery/Tunnel Project will be most noticeable in those areas where existing poor traffic conditions, due to chronic movement delays on the Central Artery, may have inhibited development activity that otherwise might have occurred. Some outlying communities may become attractive, or more attractive, locations for new industries that depend on access to Logan Airport and for service industries that require fast access to downtown Boston (for example, printing, office supply wholesalers, and data processing). The high technology industries located along outlying circumferential highways (such as Route 128 and Interstate Route 495) also will benefit from improved access to Logan Airport.

Secondary Impacts. Secondary impacts are defined as the effects on residential and retail facilities caused by improvements in access. Because the Proposed Action will occur in an area that has recently experienced a great deal of development activity, in general the Artery/Tunnel Project is expected to reinforce and accelerate this trend. New development opportunities also will be created.

8.2.7 Specific Project-Related Land Use Changes

In addition to the general land use impacts related to changes in roadway right-of-way and accessibility, the project will have specific land use impacts resulting from the construction of a number of support facilities (see Figure 8.10).

Support facilities to be constructed as a part of the Artery/Tunnel Project include seven ventilation buildings, replacement parking, emergency response unit buildings, and toll plaza administration facilities. The facilities will be located as follows:

- o Ventilation building 1: the I-93/I-90 Interchange, near the end of Fort Point Channel, south of the South Postal Annex

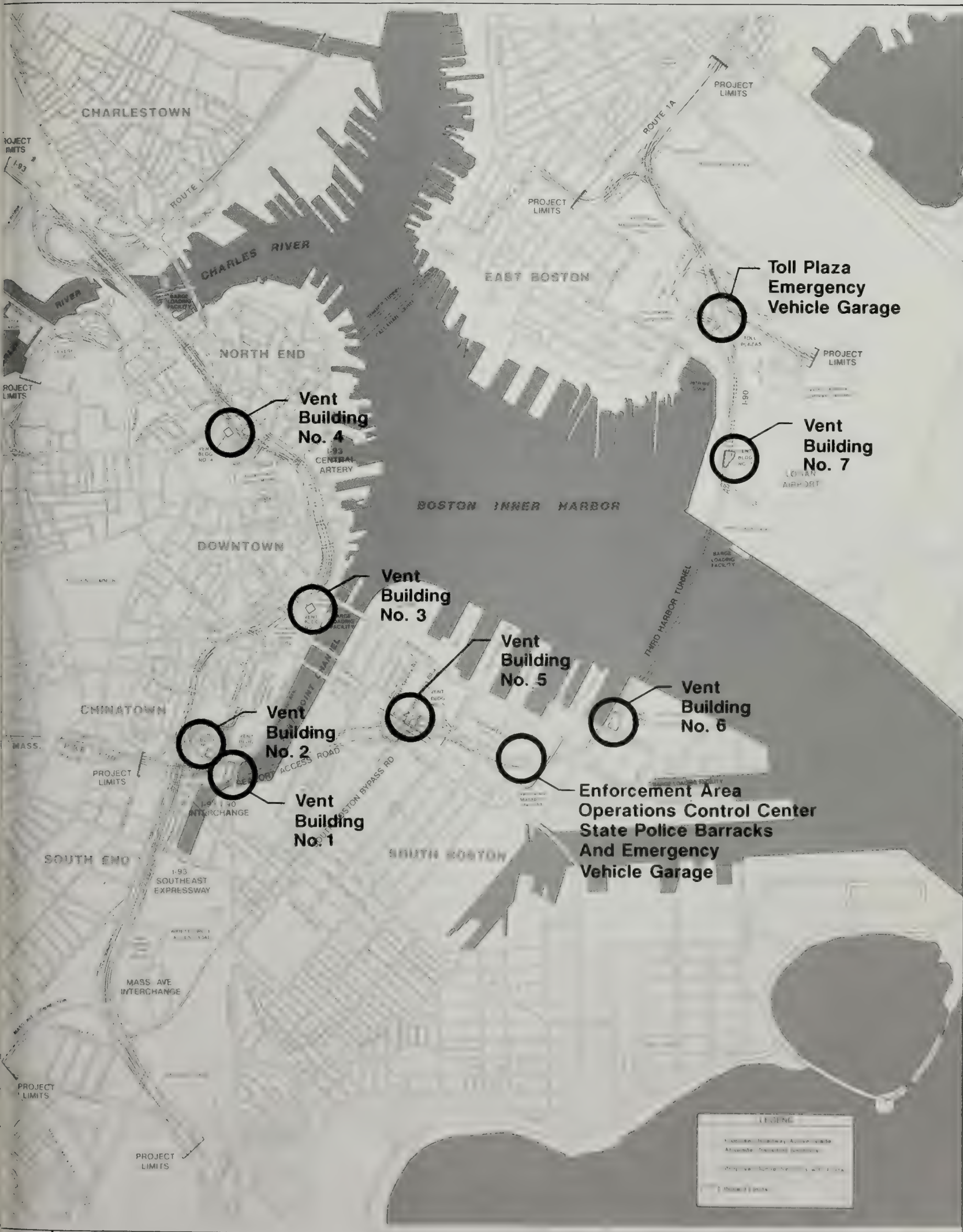

FIGURE 8.10

Land Use Impacts - Permanent Facilities

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
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SUPPLEMENTAL EIS/R

0 800 1600 2400 3200 Feet

- o Ventilation building 2: the I-93/I-90 Interchange, south of the Wang building

- o Ventilation building 3: the Boston Edison substation parcel between Atlantic Avenue and the west bank of Fort Point Channel

- o Ventilation building 4: a formerly BRA-owned property (Parcel 7) currently used as a surface parking lot in the Haymarket area, bounded by Hanover, Blackstone, New Sudbury, and Congress Streets

- o Ventilation building 5: Commonwealth Flats in South Boston, south of the Fisheries Cooperative Building at the I-90/South Boston Bypass Road interchange (intake portion; the exhaust facility will be located directly to the west, between Congress and Summer Streets)

- o Ventilation building 6: the Subaru Terminal in South Boston on the edge of Boston Marine Industrial Park

- o Ventilation building 7: Bird Island Flats in East Boston on Logan Airport property at the edge of Boston Harbor

A permanent tunnel toll administration plaza, emergency response unit/vehicle garage, and enforcement facility will be constructed at Logan Airport. A State police barracks, operations control center, and emergency response unit/vehicle garage will be constructed in the Commonwealth Flats area of South Boston. An I-93 emergency response unit building of approximately 600 square feet will be located between State and Causeway Streets, adjacent to the Artery right-of-way.

Joint development of at least three and possibly four of the ventilation buildings is anticipated. At ventilation building 4, the most advanced in the design process, ventilation facilities currently are planned to be included in a larger building which also contains: a replacement parking garage for parking spaces displaced by the Artery/Tunnel Project, replacement of Haymarket pushcart storage and food-related market area to mitigate impacts on to North End businesses, improvements to the MBTA Orange/Green Lines Haymarket station entrance, and undesignated office space to conceal the ventilation stacks from public view. Street-level commercial space is being planned in ventilation building 3 on Atlantic Avenue, and ventilation building 5 in Commonwealth Flats in South Boston, ventilation buildings may also allow for the joint development of open space per City plans. Conceptual designs for these buildings are less developed than that for ventilation building 4.

Design of these permanent structures will be carefully developed for compatibility with surrounding development. In all cases, these buildings have been located to minimize visual and land use impacts.

8.2.8 Land Use Impacts By Subarea

The following describes land use and neighborhood impacts of the Proposed Action in each of the project subareas. The text discusses areawide impacts to land use and development trends and neighborhood/community facilities. It also describes changes in the alignment since the FEIS/R.

Tables 8.6 through 8.12 list specific impacts to each parcel within the project right-of-way. (The parcels are identified on Figures 8.11 through 8.20.) Current ownership, existing land use, extent of acquisition required, and impacts are listed for each parcel. The information in these tables is based on current designs as they have been developed at this stage. More precise information on these impacts will become available as the level of design progresses during subsequent project phases. Additional land, beyond that described in Tables 8.6 through 8.12, may be required for utility relocations, to protect existing structures, to provide relocation space for public facilities displaced by the Proposed Action, and to meet requirements relating to Massachusetts General Laws, Chapter 91 (tidelands), and other statutes. A final decision on whether to acquire land in fee or acquire an easement in a specific parcel and the square footage needed may not be made until after the Department completes an appraisal of the parcel, which then will be reviewed by FHWA. Because of such factors, the extent of impact to specific parcels may change.

8.2.8(a) Area North Of Causeway Street (See Figure 8.11 And Table 8.6)
Charlestown.
Land Use: The Artery/Tunnel Project will connect to the CANA project in the Charlestown section of Boston, west of Rutherford Avenue. The large highway viaduct structures will physically dominate this area. Pedestrian connections between Paul Revere Landing Park and North Point in Cambridge, and between the portions of Paul Revere Landing Park on either bank of the Charles River while physically possible, will require special design to be safe for pedestrian use under and next to these viaducts. Paul Revere Landing Park (north bank) will be expanded further westward and the pedestrian connection to the North Station area over the Charles River dam will be improved. [See Chapter 9 and the Section 4(f) Evaluation in Part III of the SEIS/R for more detailed descriptions of visual and parkland impacts and mitigation measures.]

Neighborhood: With the exception of the park improvements described above, no community facilities will be affected by the Artery/Tunnel Project. Much of the construction work affecting Charlestown is taking place under the separate CANA project for which an EIS was published in 1979. The removal of the existing high-level bridge over the Charles River will increase the distance between the community and highway elements. The Artery/Tunnel Project will increase the highway structure in the area (see Figure 8.12). The Proposed Action will preclude landscaping some of the area under the ramps included in the Chapter 91 Special Conditions for the CANA project; however, construction of the pedestrian bridge and walkway included in the Special Conditions can be accommodated. In addition, MDC's plans for a new walkway connecting the expanded Paul Revere Landing Park to the riverfront area in front of the proposed North Point development in Cambridge can be accommodated. [See Section 4(f) Evaluation in Part III of the SEIS/R for more information, including mitigation measures.]

Cambridge.
Land Use: Long-term adverse land use impacts in Cambridge will result from shifting the Charles River bridges and ramps about 80 feet to the west, into a portion of the planned North Point development area. Privately and publicly owned development parcels in this area, currently occupied by railroad-related warehouses, are planned for new commercial and residential uses, as described in the Cambridge Community Development Department's Master Plan for this area. The number, height, and location of the loop ramps may negatively affect development potential of this area. The highway structure is designed to allow a

FIGURE **8.11**

Land Use Impacts
Area North Of Causeway Street

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0 100 200 400 800 Feet

Table 8.6

LAND USE IMPACTS IN AREA NORTH OF CAUSEWAY STREET

cel .	Property Owner	Current Use	* P/F	PERMANENT TAKINGS (approximate SF) Fee Acquis	Under-ground Hwy Easement	Overhead Hwy Easement	Acquis Type* Presently Uncertain	Impacts/Mitigation
	Comm of MA (DPW)	Office/prkg						Loss of 290 prkg spaces; bldg acquired and tenants relocated
	Comm of MA (MDC)	Prkg	P			57,400		Loss of 143 prkg spaces, mitigation under discussion
	Comm of MA (DPW)	Undeveloped hwy ROW						No change in land use
	Comm of MA (Millers Riv)	Hwy		62,080				No change in land use
	City of Bstn	Beverly St	P	27,000				Street to be discontinued; necessary access will be provided
	MA General Hosp Corp	Prkg	P					No long-term impacts
	MBTA	RR tracks	P			3,900		May affect future air-rights dev; mitigation under discussion
	Bstn & Maine Corp	Undeveloped	P			12,600		Impacts uncertain @ this time
	Bstn Sand & Gravel Co	Hwy, sand/gravel bus				102,400		Impacts uncertain @ this time
10	MBTA	RR track area	P			17,700		No impact to MBTA ops
11	Comm of MA (MDC)	Millers River	P			95,400		River to be affected by overhead hwy elements; mitigation under discussion
2	Bstn Sand & Gravel Co	Sand/gravel bus	P			35,400		Impacts uncertain @ this time
3	MBTA	RR tracks	P					No impact to MBTA ops
4	Comm of MA (DPW)	Hwy (proposed)						Loss of 31 prkg spaces
5	Bstn & Maine Corp	Whse/undeveloped	P			28,400		Loss of 65 prkg spaces; other impacts uncertain @ this time
6	Comm of MA (MDC)	Sewer plumbing/ chlor. sta.	P			31,900		Some loss of prkg but no impact to ops
7	Bstn & Maine Corp	Industrial uses	P			77,800		Impacts uncertain @ this time
[illegible]	Comm of MA (DCPO)	Prkg	P	5,100				Loss of 72 prkg spaces, mitigation under discussion
19	Comm of MA (MDC)	Lomasney Street	F	15,251				Street to be discontinued
20	Comm of MA (MDC)	Leverett Circle	F	27,900				No long-term impacts; land-scaping will be improved

Table 8.6 (Cont.)

LAND USE IMPACTS IN AREA NORTH OF CAUSEWAY STREET

			PERMANENT TAKINGS (approximate SF)					
Parcel No.	Property Owner	Current Use	* P/F	Fee Acquis	Under-ground Hwy Easement	Overhead Hwy Easement	Acquis Type* Presently Uncertain	Impacts/Mitigation
21	MBTA	RR track ROW	P			10,000		No impact to MBTA
22	MBTA	Access road	P			4,000		No impact to access
23	Chas River Pk 'A' Comp	Residentl/landscape	P	10,000				Will not affect land mitigation under dis
24	Whittier Plc Condo Trust	Residentl/landscape	P	6,200				Will not affect land mitigation under dis
25	Comm of MA (MDC)	Pedestrian brdg	P	1,200				No impact to pedest
26	Chardon Realty Trust	Prkg/wharf	P	35,300				Loss of 100 prkg spa ferry landing; mitiga discussion
27	Bstn Thermal Energy Corp	Steam plant	P					No long-term impac
28	Comm of MA (DPW)	Hwy/mtnce						No change in land u
29	Comm of MA (DPW)	Hwy/mtnce						No change in land u
30	Comm of MA (MDC)	Police station/prkg	P	800				Small taking/won't a
31	Comm of MA (MDC)	Pedestrian brdg	P	2,700				Impacts uncertain @
32	Comm of MA (DPW)	Hwy						No change in land u
33	Comm of MA (Millers riv)			47,950				Footings and piers i mitigation under dis
34	Comm of MA (DPW)	State hwy proposed						No change in land u

* Uncertain at this time whether area noted will be a taking in fee or an underground/overhead highway easement. Extent of acquisition, partial (P) or full (F) also uncertain at this time.

Source: Bechtel/Parsons Brinckerhoff

View toward downtown and I-93 mainline from Charlestown residential neighborhood adjacent to New Rutherford Avenue. Proposed new arena development shown in background.

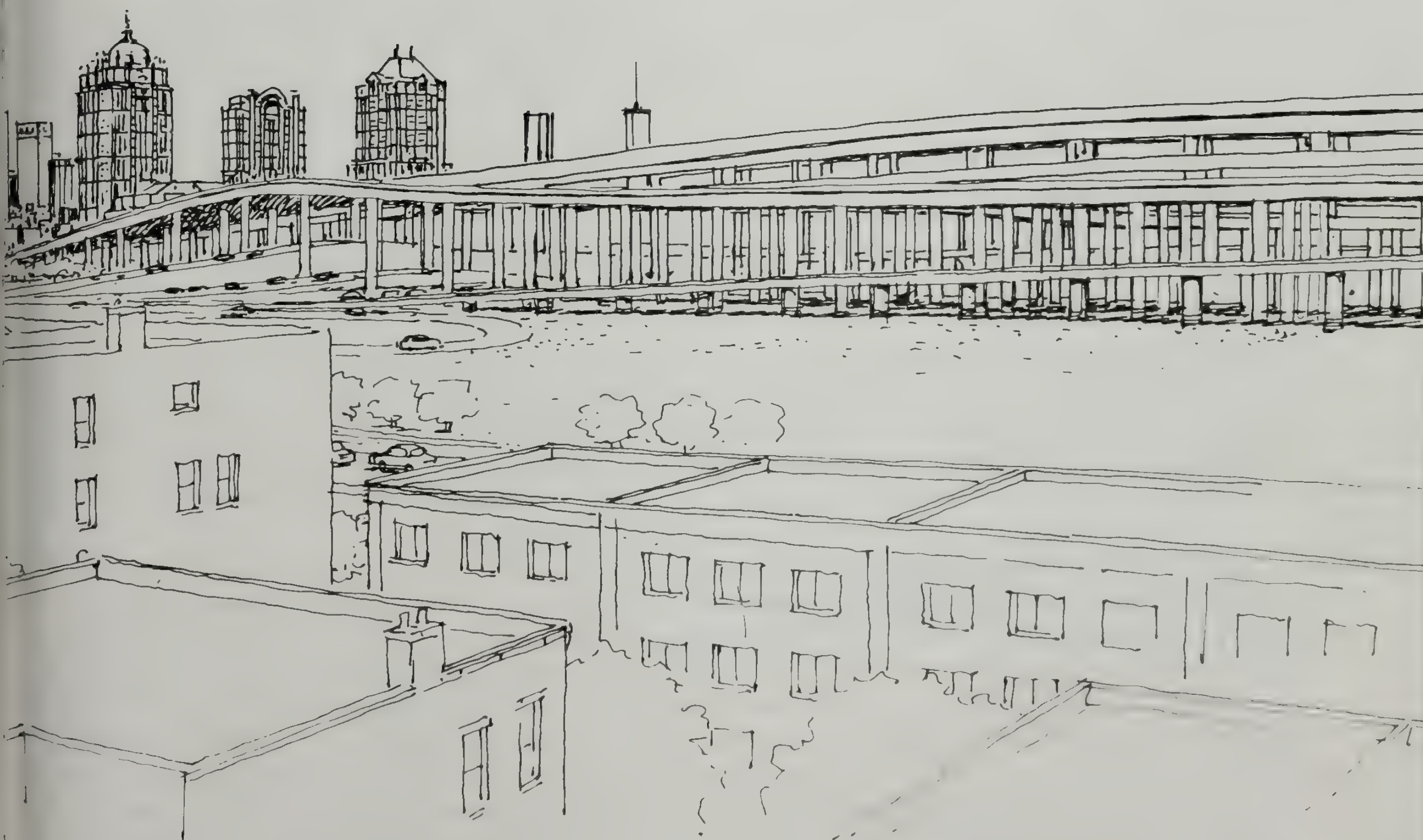

FIGURE 8.12

View Of Mainline And Charles River Bridges

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

pedestrian connection between the proposed North Point waterfront park area and the MDC's proposed extension of the riverfront park in Charlestown; however, this connection may be less attractive as a result of the viaduct's shadow effects and scale.

Neighborhood: Since this area is currently industrial in character, the project will have no effect on existing residential neighborhoods or community facilities. However, it may not be complementary to the development of a new residential community in North Point.

North Station.
Land Use: The alignment of the Artery/Tunnel Project has been designed to allow for projects such as the proposed new North Station Green Line/Orange Line station and the commuter rail station, the related parking garage, and the new Boston Garden complex above the garage. In addition, a new parking garage can be accomodated above the proposed combined MBTA Orange Line/Green Line North Station facility bounded by Causeway, Canal, and Haverhill Streets.

The new ramp system between Leverett Circle and the Central Artery will be compatible with changes made with the recently relocated Nashua Street and with the Nashua/Merrimac/ Congress Streets corridor to be developed by the City. Designs of the new viaducts and the bridges across the Charles River and the area underneath them are being reviewed by the MDC and other interested agencies and organizations, including the Cities of Boston and Cambridge, the Boston and Cambridge Conservation Commissions, DEP, the Conservation Law Foundation, and the Charles River Watershed Association. Design refinements and other ideas to minimize and/or mitigate the impacts of the bridges on the Charles River Basin and on MDC plans for extending the Charles River Esplanade eastward on both sides of the river will be developed in this ongoing review process.

Depression of the Central Artery will allow pedestrian and vehicular reconnections between the two portions of the historic Bullfinch Triangle district, currently divided by the elevated Artery. These connections will encourage the rehabilitation activity already underway in these districts. The northbound off-ramp between Traverse and Causeway Streets will not affect land use in this area.

Neighborhood: The project will require changes to the southern part of Paul Revere Landing Park, the area's only community facility. The proposed design avoids any taking of the Charles River and Stop & Shop Buildings and avoids disruption of the south bank of the Charles River as was contemplated in the FEIS/R. The location of the transition segment of the Central Artery between the tunnel portal at Causeway Street and the bridge section over the Charles River will require a change in the location of existing pedestrian and vehicular access between Paul Revere Landing Park (south bank of river) and Causeway Street; pedestrian access to the park will be via a walkway adjacent to the west side of both the Charles River and Stop & Shop Buildings. A loop roadway will be provided to connect Causeway Street with the new parking lot adjacent to the Charles River dam. [See the Section 4(f) Evaluation for more details.] The elimination of the boat section along the south river bank, included in the FEIS/R alignment, will allow for easier development of park or other uses along that bank. Pedestrian connections from Causeway Street to the river's edge will be improved by elimination of the Causeway Street off-ramps.

Table 8.7

LAND USE IMPACTS IN CENTRAL AREA

Parcel No.	Property Owner	Current Use	* P/F	PERMANENT TAKINGS (approximate SF) Fee Acquis	Under-ground Hwy Easement	Overhead Hwy Easement	Acquis Type* Presently Uncertain	Impacts/Mitigation
1	City of Bstn	Prkg	P		53,300			Loss of 74 prkg spaces
2	Comm of MA (MDPW)	Pump house						**
3	City of Bstn	Prkg	P		28,500			Loss of 150 prkg space
4	City of Bstn	Prkg	P		9,900			No impact @ this time
5	BRA	Vacant	P		5,300			No impact @ this time
6	MBTA	RR track area	P		5,300			No impact to MBTA o
7	City of Bstn	Prkg	P		116,000			Loss of 207 prkg space
8	Comm of MA (MDPW)	Pump house						**
9	Peter & Vito Cucchiara Lisa Rlty Trst Trustees	Vacant	P		100			No impact @ this time
10	City of Bstn	Prkg	F		721			**
11	City of Bstn	Prkg	P		1,900			Loss of 10 prkg spaces
12	City of Bstn	Prkg	F		6,200			Loss of 63 prkg spaces
13	City of Bstn	Prkg	F		18,280			Loss of 65 prkg spaces
14	City of Bstn		P		3,400			**
15	BRA	Prkg	F				58,023	Loss of 150 prkg space location to incl replace food mkt & MBTA sta
16	The Bstn Edison Co	Substation	P				26,300	Loss of 203 prkg space location**
17	City of Bstn	Tunnel portal	P					Existing land use will r
18	City of Bstn	Grass strip	P		9,200			**
19	James F. Sullivan, DS Prkg Trst Trustee	Prkg garage	P		400			No impact @ this time
20	MA Tpk Authority	Tunnel portal	P					Existing land use will r
21	City of Bstn	Undeveloped	P		49,000			**
22	BRA	Mixed use	P		900			No impact @ this time
23	Comm of MA (MDPW)	Undeveloped						**
24	City of Bstn	Undeveloped	F		10,700			**
25	BRA	Undeveloped	F		1,003			**
26	Comm of MA (MDPW)	Pump house	F		705			**
27	City of Bstn	Undeveloped						Existing land use will r
28	City of Bstn	Undeveloped	F		8,103			**
29	BRA	Undeveloped	F		2,668			**
30	Comm of MA (MDPW)	Pump house						**

Table 8.7 (Cont.)

LAND USE IMPACTS IN CENTRAL AREA

			PERMANENT TAKINGS (approximate SF)					
	roperty Owner	Current Use	* P/F	Fee Acquis	Under-ground Hwy Easement	Overhead Hwy Easement	Acquis Type* Presently Uncertain	Impacts/Mitigation
31	RA	Undeveloped	F		6,500			**
32	ity of Bstn	Undeveloped	F		7,300			**
33	ity of Bstn	Prkg	P		300			No impact @ this time
34	ity of Bstn	Prkg						No impact @ this time
35	ity of Bstn	Prkg	P		100			No impact @ this time
36	ity of Bstn	Prkg	F		15,700			Loss of 60 prkg spaces**
37	omm of MA	Pump house						No impacts @ this time
38	t Hill Sq Phase 2 Assoc	Office bldg	P		500			No impacts @ this time
39	RA	Summer St						No long-term land impact
40	omm of MA (MDPW)	Vent bldg						No impact @ this time
41	omm of MA (MDPW)	Vent bldg						
42	omm of MA (MDPW)	Vent bldg/hwy use						No chng in land use
43	omm of MA (MDPW)	Hwy						No chng in land use
44	omm of MA (MDPW)	Hwy						No chng in land use
45	ed Reserve Bank of Bstn	Office/park	P		3,500			Loss of some underground prkg; mitigation under discussion
46	omm of MA (MDPW)	Hwy						No chng in land use
47	Comm of MA (MDPW)	Vent bldg						No impact @ this time
48	ity of Bstn	Bus station	F		45,820			To be relocated to South Station Transportation Ctr
49	ity of Bstn	Prkg						No impact @ this time
50	omm of MA (MDPW)	Vent bldg/open						No impact @ this time
51	MBTA	South Station	P		25,000			No impact @ this time; potential chngs to Red Line platform will not affect ops
52	omm of MA (Ft Pt Chnl)	Minor Navigation	P					No change in land use

ncertain at this time whether area noted will be a taking in fee or
ı underground/overhead highway easement.

xtent of acqusition [partial (P) or full (F)] also uncertain at this time.

ıture development opportunies will be determined through the joint development process

ull impact to Sheraton Building at 470 Atlantic Avenue is undertermined at this time

e: Bechtel/Parsons Brinckerhoff

West End.
Land Use: The Artery/Tunnel Project is not expected to affect land use and development in the West End as there are no undeveloped parcels for which development proposals have not already been announced. The new eastbound tunnel under Leverett Circle will generally parallel the existing westbound tunnel; because of this improvement, a narrow strip of privately owned land at the Charles River Park development will be required to accommodate the widening of Storrow Drive.

Neighborhood: Long-term impacts of the Artery/Tunnel Project on the West End will be relatively unchanged from existing conditions. This is because the highway structures to be built along its northern edge, Martha Way, will be similar to what exist at present. The only addition will be the new eastbound ramp connecting Storrow Drive with the Central Artery.

8.2.8(b) Central Area (See Figure 8.13 And Table 8.7)
North End.
Land Use: The depression of the Central Artery is not expected to change existing land use trends in the North End. Removal of the unsightly elevated Central Artery may contribute to a further rise in housing costs and rental conversions to condominiums in the community because the immediate visual and environmental quality of the area will be substantially improved. However, this improvement could also encourage existing residents to stay, help to strengthen the neighborhood economy, and thereby reinforce the existing community.

Other important changes will result from the availability of air rights parcels over the depressed Central Artery and the development of food market space and replacement parking as part of ventilation building 4. This will enable neighborhood uses to expand across the Artery corridor to Congress Street and into some of its old territory (previously taken by construction of the elevated Central Artery; see Figures 8.14 and 8.15). Land uses suggested by the community for the newly created parcels include up to 1,000 units of housing, retail activities, and community facilities/open space.

Modifications that would allow for accommodation of joint development over the open boat sections at the Sumner/Callahan Tunnel portals are being evaluated.

As discussed for other Central Artery neighborhoods, the improved aesthetic environment is likely to hasten the ongoing rehabilitation of area buildings.

Neighborhood: In addition to neighborhood expansion, the overall quality of life in the North End is expected to improve in the long term due to the project. The removal of the existing Central Artery will substantially enhance the aesthetic quality of that edge of the neighborhood. Reduced traffic-related air and noise pollution will result from replacement of the elevated six lanes of traffic on the existing Central Artery and surface traffic connecting to the Sumner/Callahan Tunnels with an underground roadway; this will also improve the neighborhood environment.

Pedestrian access between the North End, Haymarket, Government Center, North Station area, and the waterfront will be easier and more attractive than it is now, with upgraded pedestrian crossings at Hanover, North, and New Sudbury Streets. These improvements will

FIGURE 8.13 **Land Use Impacts**
Central Area

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CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

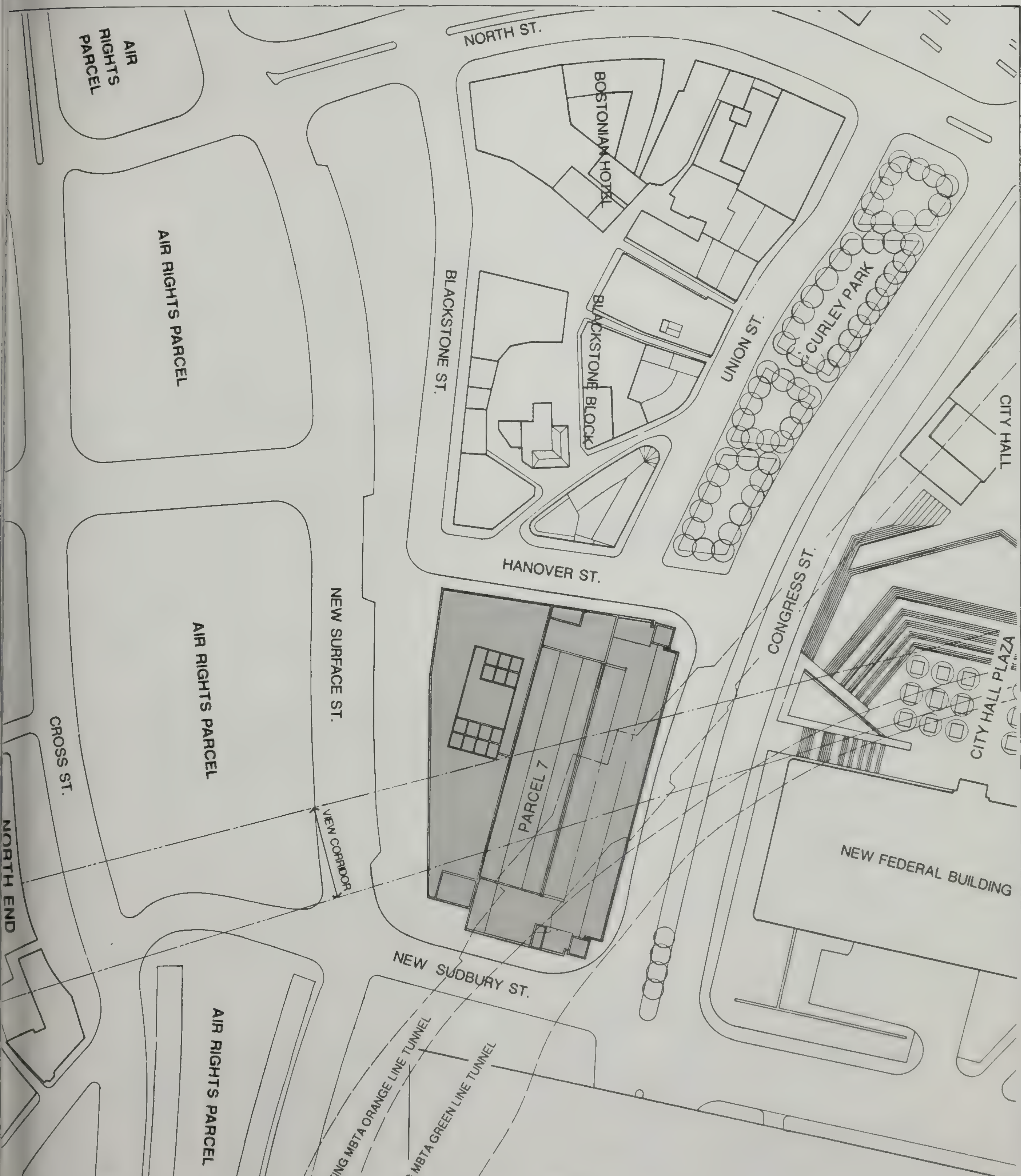


FIGURE 8.14

Plan Of Parcel 7 And Proposed Action With Surrounding Area

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

0 45 90 135 180 Feet

Bird's-eye view looking south to Downtown from Salem Street in the North End. The existing six-lane elevated highway dominates the landscape and acts as a barrier between the North End and Downtown.

Bird's-eye view looking south to Downtown from Salem Street in the North End. Low-density development on air-rights parcels over the depressed tunnel illustrates one option for reuse of parcels. First-floor market space in Ventilation Building 4 shown completed on Parcel 7 in background.

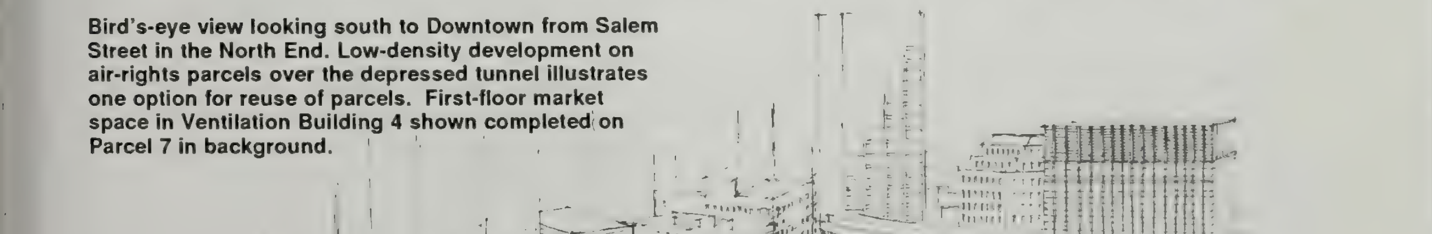


FIGURE 8.15

Aerial View Of The North End, Government Center And Haymarket

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

re-integrate the North End with downtown and could increase business activity in the neighborhood. For example, new customers may be attracted to the Cross/Hanover Streets shopping area that will be visible from Haymarket.

Travel patterns within the neighborhood are not expected to change nor will the project affect any community facilities. North End schools and activities will not be affected by the Proposed Action.

Waterfront/Market Area.
Land Use: This project is not expected to cause land use changes in the area, but will support and possibly hasten the ongoing development and rehabilitation activity. Removal of the elevated Central Artery will visually reconnect the Faneuil Hall Market Place area with the rest of the waterfront and the North End. The Walk-to-the-Sea between the Faneuil Hall markets and Long Wharf will be improved.

Removal of the elevated Artery will upgrade the visual environment for the Haymarket food shopping area on Blackstone Street, but will displace space currently used for parking and storage of vendor carts. Ventilation building 4 is planned to include food market space, replacement parking, and replacement storage for Haymarket vendor carts, as well as improvements to the MBTA Orange/Green Lines Haymarket station entrance. A large surface area, from North Street to New Sudbury Street, will be created and may serve to accommodate potential expansion of the outdoor pushcart area. Creation of new surface streets will provide new on-street curbside parking which could be reserved for Haymarket use during market operation.

Other long-term impacts to the waterfront will result from the development of air rights for parks or buildings on newly created parcels of land over the underground Central Artery. The process described in the Joint Development Appendix will help provide that new land uses on these parcels will be consistent and compatible with existing uses in the waterfront area.

Ventilation building 3, on Atlantic Avenue at the Boston Edison site, should not substantially alter the character of its commercial office environs, although it may limit development of this site for other uses. In addition, joint development opportunities should be compatible with marine uses and provide public access to the waterfront to strengthen compliance with Chapter 91 license interests. (The potential for joint development on this site is discussed in the Joint Development Appendix.)

Central Artery tunnel ramps between North and Clinton Streets may result in slightly narrowed sidewalks alongside the Haymarket Garage and Mercantile Wharf. Access to these parcels will be maintained.

Neighborhood: The waterfront neighborhood will benefit in the long term from the Proposed Action because there will be improved connections with adjacent areas. The vehicular and pedestrian links between the waterfront and downtown Boston will be strengthened by street and sidewalk extensions along Hanover, North, Oliver, and Pearl Streets across the Central Artery right-of-way. These links will help to reestablish a more regular and more easily used street pattern.

The quality of life in the area will be enhanced for both residents and visitors. The reduction in air and noise pollution, along with an improved pattern of traffic and pedestrian flows, will greatly improve the neighborhood environment. Access to community facilities will not be affected. Publicly owned parking spaces removed by the project will be replaced (see replacement parking discussion in Chapter 3).

Government Center.
Land Use: As the Government Center area already is fully developed, long-term impacts will be minimal. However, the depression of the Central Artery will result in improved access between the Government Center area and the North End. Future development of the newly created air rights parcels over the depressed Central Artery could help to connect Government Center to the North End and waterfront neighborhoods.

The Central Artery tunnel ramps at the newly created parcel in front of the Government Center Garage will restrict its development potential, and will prevent pedestrian crossing at New Chardon Street. Appropriate landscaping and screening will be provided to mitigate the impacts of these ramps.

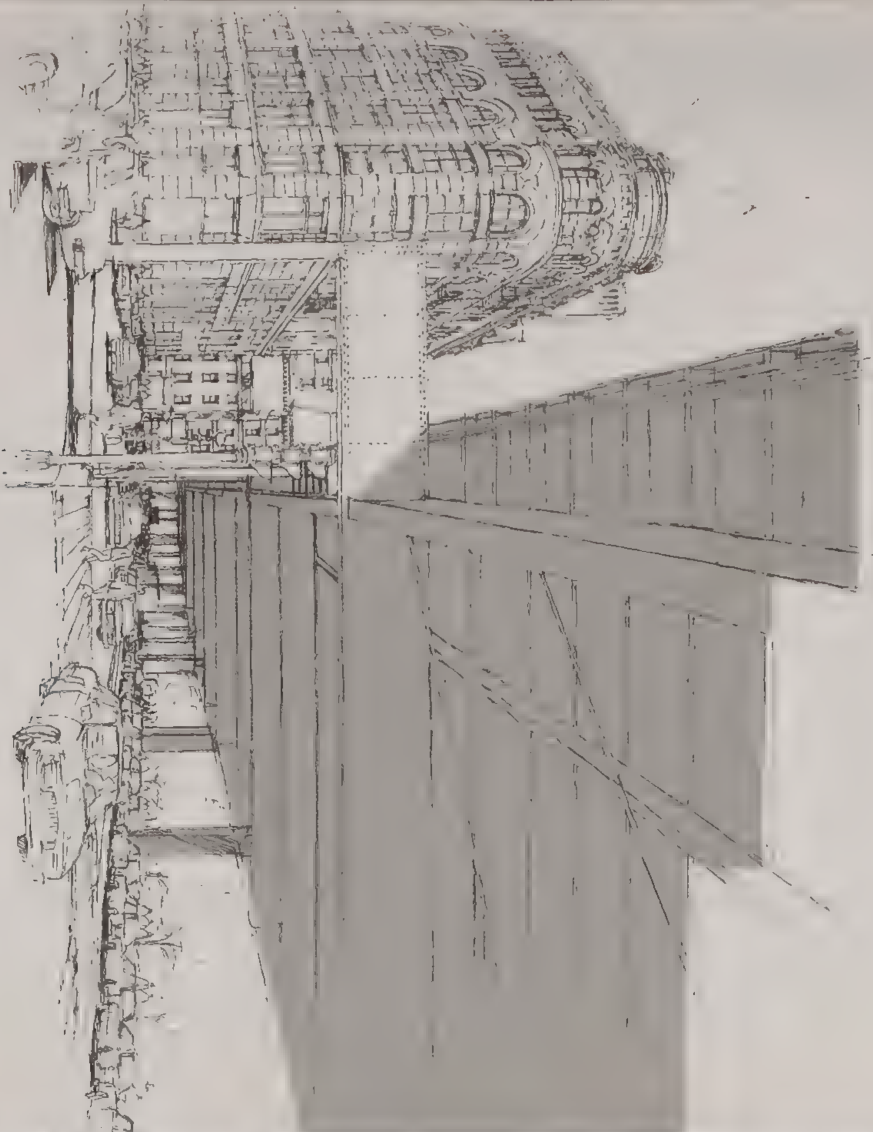
Design guidelines for the air rights parcels, which are subject to the joint development process, will provide that such developments are compatible with the surrounding environment.

With the exception of development on air rights over the underground Central Artery, the Artery/Tunnel Project is not expected to induce new development in the area as there are no undeveloped parcels remaining there.

Neighborhood: The Government Center area, a major employment district with no residential land uses, will not be substantially affected by the Proposed Action. Long-term impacts will result from the elimination of the southbound exit ramp at New Chardon Street, making access to the area slightly more difficult. A Central Artery southbound off-ramp surfacing at Clinton Street will provide access to the Government Center/downtown area via State Street. Area boundaries will not be affected. A stronger link will be established between Government Center and the waterfront by improving pedestrian paths across the Central Artery right-of-way between the northbound and southbound surface arterials.

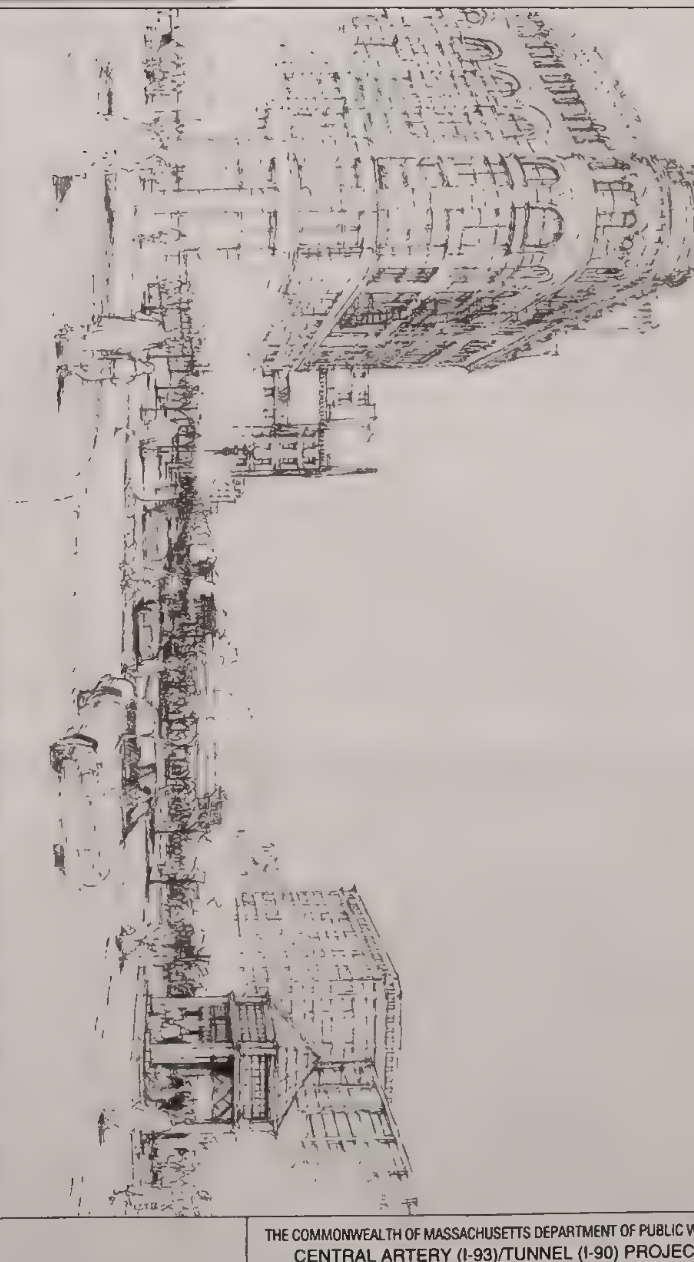
Financial District.
Land Use: Long-term land use impacts of the project are expected to be minimal in the Financial District due to the limited availability of developable parcels in this nearly fully developed district. High-density office uses will continue to dominate the area. Improved access to Logan Airport and the rest of the region will be a new advantage for existing and proposed developments.

The removal of the elevated Central Artery will improve connections between the Financial District and the waterfront and Fort Point Channel areas (see Figure 8.16). New development on the air rights parcels created by the placement of the Central Artery underground will help to reinforce these connections and possibly expand Financial District activities. Central Artery tunnel ramps at High Street will complicate joint development of the newly created parcel at that location; such development, however, is not precluded. The ramps between Summer and Congress Streets will be in the same locations as existing ramps.



Existing view of the elevated Central Artery adjacent to the Grain Exchange Building.

Same view showing low-rise development, compatible with surrounding architecture, on air-rights over depressed Central Artery.



Same view illustrating open space development on air-rights over the depressed Central Artery. New three-lane southbound surface artery shown.

FIGURE 8.16 **Perspective Of Financial District**

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

Design guidelines for the air rights parcels, which are subject to the joint development process, will provide for buildings that are compatible with the surrounding environment. The guidelines will be consistent with those in the Section 106 Memorandum of Agreement for historic districts.

Secondary impacts will be minimal. The project will reinforce current development activity, but, with the exception of possible development on air rights parcels over the underground Central Artery, the project is not expected to induce development in the area.

Neighborhood: The Financial District is not a residential neighborhood. Access to the new fire station on Purchase Street at the rear of the new 125 High Street complex will be provided.

Fort Point Channel.
Land Use: Long-term beneficial impacts on the Fort Point Channel area include improved pedestrian access to the area from downtown Boston. New pedestrian and vehicular access will be provided across Atlantic Avenue and the underground Central Artery at Pearl, Oliver, and High Streets. New development or open space over the tunnel also will help to reinforce this connection, both physically and visually. In addition, there will be improved pedestrian access from downtown to the Boston Tea Party Ship, Children's Museum, and Computer Museum resulting from improved cross-Artery connections.

Plans for this area, including air rights development, will be coordinated with the implementation activities recommended by the BRA's ongoing study, the Fort Point Channel Project Report, published by the Greater Boston Chamber of Commerce (GBCC) in July 1988, and with the BRA's Fort Point District Plan, published in the spring of 1989. The GBCC report details desired improvements to pedestrian access routes and increased water-related recreational and cultural uses. Plans include continued access to the South Postal Annex by trucks using Dorchester Avenue.

The access improvements to the area will further stimulate the substantial ongoing development and rehabilitation activity in the area.

Neighborhood: The small but growing residential neighborhood on the east side of the Channel will benefit from improved connections across the Artery to other downtown areas, and from removal of some truck traffic from local streets.

8.2.8(c) I-93/I-90 Interchange And Massachusetts Avenue Interchange Area (See Figure 8.17 And Table 8.8)

Chinatown.
Land Use: Long-term project impacts on land use patterns are expected to be beneficial in the already densely developed Chinatown area. Closing the Beach Street ramp and moving the ramps between Kneeland Street and the Massachusetts Turnpike further east of Hudson Street will improve pedestrian and vehicular circulation at the Beach Street gateway and make the Hudson Street edge of Chinatown more attractive. Two new development parcels adjacent to Chinatown will be created by the closing of the existing southbound Central Artery exit ramp at Beach Street (see Figure 8.18). Other parcels created in and around the I-93/I-90 Interchange may also be developed for uses related to Chinatown, allowing the area to expand and accommodate its growing population. This expansion is consistent with the

Table 8.8

LAND USE IMPACTS IN I-93/I-90 INTERCHANGE AND MASSACHUSETTS AVENUE INTERCHANGE AREA

			PERMANENT TAKINGS (approximate SF)					
Parcel No.	Property Owner	Current Use	* P/F	Fee Acquis	Under-ground Hwy Easement	Overhead Hwy Easement	Acquis Type Presently Uncertain	Impacts/Mitigatior
1	City of Bstn	Pumping station	F	5,916				Mitigation under di pending determinat replacement rqmt
2	MA Tpk Authority	Roadways	P				*	To be used for inte bldg; may require r Wang Corp (lessee)
3	MBTA	RR ROW	P	284,300				Will not affect rail c
4	The Gillette Co	Prkg/underground tank storage	P					Tanks will be reloca Gillette property; n potential prkg impa
5	Comm of MA (MDPW)	Hwy ROW						Land use will not cl
6	Comm of MA (MDPW)	Inter SE Xway/MA Ave connector						Land use will not cl Rapid Service Press previously acquired
7	Perry Boudreau	Indus bldg rear yd	P	26,000				Impacts/mitigation
8	Pro-Fac Co-op, Inc.	Vacant	P	4,200				New bldg planned f be designed to acco reconfigured parcel
9	J.M. Whalen, Trustee of Nominee Trust		P	300				Impact uncertain @
10	City of Bstn	RR tracks ROW	P				*	RR tracks will be re
11	Comm of MA (MDPW) lsd to Greater Bstn Dist Inc	Truck loading area						Impacts to lessee u @ this time
12	New Bstn Food Mkt Dev	RR usage	P	16,900				No impact to existi
13	Frontage Rd Dev Corp Inc	Trail truck strg, City tow lot	P	95,200				No impact to existi
14	City of Bstn	Maint fac yd/clinic	P	29,400				Perm impacts to pr mitigation under di
15	Bstn Edison Co	Substation site	P	14,000				Substation to be rel
16	240 Southampton St, Inc	Indus bldg rear lot	P	27,900				No impact to existi
17	P.J. Percella, Jr.	Vacant	P	4,000				Impacts uncertain @
18	MBTA	RR ROW	P	39,100				No impacts to existi
19	John Sax	Vacant	P	7,037				Impacts uncertain @
20	Comm of MA (DCPO)	Abandoned incinera-tor	P	18,800				No impacts
21	Comm of MA	Fort Point Channel						No impacts

Table 8.8 (Cont.)

LAND USE IMPACTS IN I-93/I-90 INTERCHANGE AND MASSACHUSETTS AVENUE INTERCHANGE AREA

			PERMANENT TAKINGS (approximate SF)					
[illegible]el	[illegible]roperty Owner	Current Use	* P/F	Fee Acquis	Underground Hwy Easement	Overhead Hwy Easement	Acquis Type Presently Uncertain	Impacts/Mitigation
[illegible]	Fatles, Trstee, Moore t Rlty Trst		P	2,500				Impacts uncertain @ this time
[illegible]	A & JS Gnazzso	Auto paint shop	F	16,000				Existing bus to rcv relo benefits
[illegible]	& L Fruman TC	Whse	F	14,800				Existing bus to rcv relo benefits
[illegible]	)wner unknown	Priv way	F	5,400				Public st to be constructed on site
26	& L Fruman TC	Vacant/access	P	32,200				Impacts uncertain @ this time
[illegible]	'J Kennedy & Sons Inc	Plumbing supply	P	7,000				Impacts uncertain @ this time
28	3RA	Prkg/access	P	4,500				Perm impacts to prkg facility; mitigation under discussion
29	\ & M Jacobson Trstees nd Whlsle Flor/Supplier	Prkg	P	20,200				Loss of 16 prkg spaces; mitigation under discussion
30	3stn Flower Exch Inc	Prkg	P	3,300				No impact to existing bus; loss of 30 prkg spaces
31	City of Bstn	Prkg	P	47,400				Impact & mitigation to be determined in conj w/#28 above
32	Consolidated Rail Corp	RR ROW	P	18,500		2,000		No impacts to existing ops
33	)wner unknown	Moore St (priv way)	F	7,100				No impacts to existing surrounding land uses
34	Comm of MA	Waterway (Ft Pt Chnl)						No impact to existing use
35	JS Postal Srv	Vacant/priv roadway	P	73,000				Vent bldg location; no impact to ops
36	'enn Central Trans Co	RR ROW	P					RR tracks to be relocated in conj w/10 above

Ucertain at this time whether area noted will be a taking in fee or an underground/overhead highway easement. Etent of acqusition [partial (P) or full (F)] also uncertain at this time.

[illegible]e: Bechtel/Parsons Brinckerhoff

plans for Chinatown outlined in the Downtown IPOD. Design guidelines for the new parcels adjacent to Chinatown, which are subject to the joint development process, will provide for a type of development that is compatible with Chinatown's character.

Two ventilation buildings (1 and 2) associated with the project are planned within the I-93/I-90 Interchange area. The closest ventilation building will be approximately 725 feet (or more than two blocks) east of Hudson Street. No adverse impacts on Chinatown are expected from these ventilation buildings since they are far away and not located on developable land.

The Proposed Action will support the ongoing renovation and expansion of Chinatown. A number of private developments unrelated to the Artery/Tunnel Project have been proposed by others for the surrounding area (such as in the Midtown Cultural District), and will have comparatively greater impact.

Neighborhood: The project will not affect internal neighborhood cohesion, although it will allow for expansion of neighborhood boundaries as described above.

Under the Proposed Action, travel patterns at the southeastern edge of the neighborhood will be affected substantially by the closing of Hudson Street; local access will be provided from Kneeland Street. This modification will benefit residents on Hudson Street, as through traffic will be eliminated. The major beneficial effect of the project's rerouting of through traffic to the eastern and southern edges of Chinatown is that it will decrease nonlocal traffic on neighborhood streets. For example, the closing of the Beach Street southbound off-ramp from the Dewey Square tunnel (I-93) is expected to result in a substantial decrease in traffic on Beach Street, the heart of Chinatown's commercial district. Access to Beach Street from Essex Street will be via Edinboro Street. Kingston Street will provide access only to the Surface Artery. Thus, pedestrian safety and neighborhood cohesion will be greatly enhanced by the Artery/Tunnel Project and these associated local street changes.

The area between Herald Street (the northern edge of the South End) and Marginal Road (the southern edge of Chinatown) will experience increased traffic, thus increasing the existing separation of the areas to the north and south of the roadway. Substantial traffic increases on Herald Street (one-way eastbound) and Marginal Road (one-way westbound) will occur as they will function more as frontage roads for the Massachusetts Turnpike between them. Both streets will be extended eastward to the I-93 northbound frontage road. The Massachusetts Turnpike Authority is conducting a study of a westbound turnpike off-ramp at East Berkeley Street and an eastbound on-ramp at Arlington Street, which would reduce traffic on Marginal Road in the former case, and Herald Street in the latter. The Proposed Action would accommodate these ramp changes.

A plan to mitigate traffic noise and the visual impacts of Marginal Road, using landscaping and other streetscape elements, will be developed through coordination with the community.

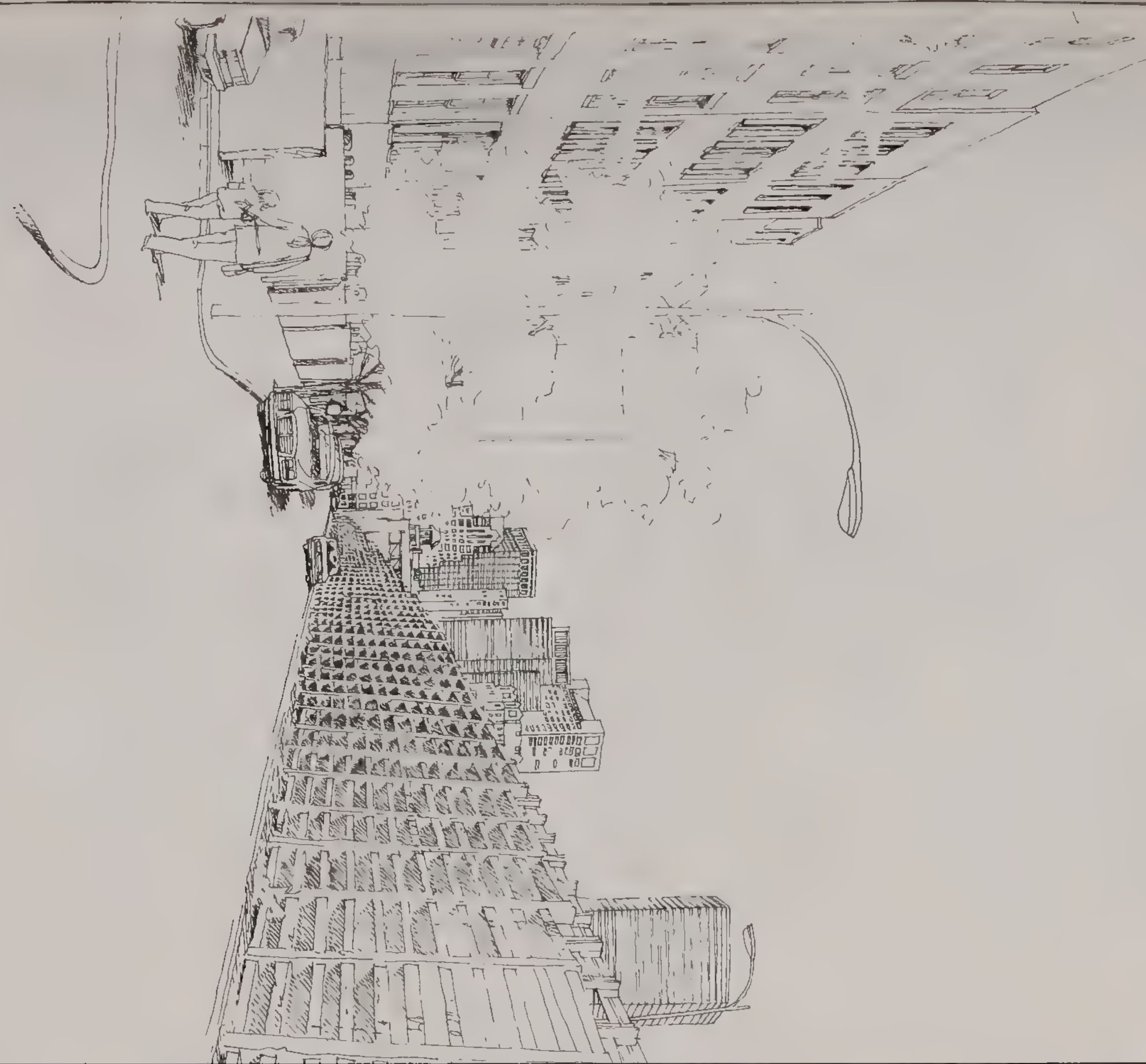
The creation of new development parcels (described above under Land Use) in a neighborhood where housing and open space are limited and vacant land very scarce will be a positive impact of the Artery/Tunnel Project on the Chinatown community.

FIGURE 8.17

Land Use Impacts
I-93/I-90 Interchange And
Massachusetts Avenue Interchange Area

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

0 100 200 400 800 Feet



View along Hudson Street looking north toward Downtown. The existing retaining wall forms an abrupt edge to the Chinatown community.

View along Hudson Street looking north towards Downtown. The Proposed Action removes this wall and creates a parcel on the east side of Hudson. This option shows development as low-rise housing and open space.

View along Hudson Street looking north toward Downtown. The Proposed Action removes this wall and creates a parcel on the east side of Hudson. This option shows development as open space.

FIGURE 8.18

Perspective Of Chinatown

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

Under the Proposed Action, traffic on Marginal Road may pose a safety concern for students of the adjacent Quincy School. The proposed relocation of the Massachusetts Turnpike off-ramps in this location would help to mitigate this impact. Pagoda Park, on Kneeland Street at the entrance to the Southeast Expressway, may be expanded southerly by the project as a result of ramp reroutings between I-93 and the South Station Transportation Center.

Leather District.
Land Use: The Leather District's land use changes (from leather manufacturing to office, residential, gallery, design studio, and related services) and related impacts (such as increased traffic on surface streets) will not be affected by the project. Because the I-93 northbound and southbound lanes will be in tunnel on the east and west sides, respectively, of the Leather District, long-term impacts on the area are expected to be minimal. The unused northbound exit to Lincoln Street will be reopened and reversed to serve as a one-lane southbound on-ramp from Lincoln Street. Otherwise, direct access between the Leather District and the Central Artery will continue to be limited. Ongoing coordination with the MBTA and BRA will help to minimize construction period interference which could delay development plans for South Station.

Secondary impacts also will be minimal. The limited number of available undeveloped parcels, the Leather District's historic district status, and City development policy will tend to limit future development opportunities in the Leather District.

Neighborhood: Because the Leather District has only recently become a residential neighborhood, there are no community facilities in the area. This project will have little impact on the neighborhood.

South End.
Land Use: Long-term impacts on the South End industrial area will be positive because of improved access to Logan Airport for high technology industry and development. Long-term land use impacts on the residential portion of the South End also are expected to be positive as a result of this project. Grade separation of East Berkeley Street and improvements in the arterial street system bordering the South End, that is, the easterly extension of Herald Street and Marginal Road, will relieve the impact from some of the through traffic currently using South End residential streets.

Secondary impacts on the South End will be minimal. This area is currently undergoing substantial new development and rehabilitation due to its advantageous location and other positive economic influences as described earlier.

Neighborhood: With the exception of the traffic improvements described above, no long-term impacts to the South End neighborhood are expected. The project skirts the eastern, industrial/commercial edge of this neighborhood and, therefore, does not affect neighborhood boundaries. Neighborhood cohesion, similarly, will not be affected. The Artery/Tunnel Project will not affect any community facilities in the South End, including school facilities or activities.

South Bay/Newmarket.
Land Use: Long-term impacts on the South Bay/Newmarket area will be positive because of improved access to downtown Boston via the Massachusetts Avenue interchange and Central

Artery, to South Boston via the South Boston Bypass Road and Seaport Access Road, and to Logan Airport via the Third Harbor Tunnel. Improved access will reinforce the improvements to the area being undertaken as a part of the Newmarket Area Plan by the Boston EDIC. Some existing parking areas will be displaced, but the project's replacement parking policy will aid in developing a rational parking plan for the future of this area. Overall, the transportation improvements will not cause major changes in land use or affect land use plans or development trends.

Secondary impacts will be minimal. This project is not expected to induce development in the area as there are few parcels that are still undeveloped. The major undeveloped and underdeveloped parcels are already proposed for other uses by public agencies.

Neighborhood: This is not a residential neighborhood, and therefore there will be no impacts to community cohesion or facilities.

8.2.8(d) South Boston And South Boston Bypass Road Area [See Figure 8.19 (A And B) And Tables 8.9, 8.10, And 8.11]

South Boston.

Land Use: The Artery/Tunnel Project generally will be beneficial to the area. The Seaport Access Road and South Boston Bypass Road will remove trucks from residential streets and, thus, help stop encroachment of industrial activities into the residential area south of First Street. Long-term impacts on land use will occur primarily in the industrial zone north of First Street. Substantial improvements in access to the area, including an extension of the street grid between New Northern Avenue and Congress Street, will increase the value of undeveloped or underused land.

The separation of land use activities caused by the open boat section of I-90 from the Third Harbor Tunnel portal to just west of Ramp Street will be mitigated by the extension of Ramp and Viaduct Streets over the boat section to allow for continued pedestrian and vehicular access to the waterfront. (The open boat section is required at this point for the health and safety of traffic enforcement personnel controlling use of the HOV lanes.)

The Fort Point Channel area will benefit from improved regional vehicular accessibility, particularly from the I-93 and I-90 connections to the south and west, allowing travellers to rely less on connections via the Northern Avenue bridge and Dewey Square.

In the industrial areas, the Artery/Tunnel Project will benefit manufacturing and distribution activities through improved airport and regional highway access. The existing containerport activities in South Boston may benefit similarly.

Specific Artery/Tunnel Project land use changes include the construction of a permanent tunnel ventilation building (6) at the Subaru Terminal, a State police barracks, a tunnel operations control center, an emergency response vehicle garage, and another ventilation building (5) on Commonwealth Flats.

Secondary impacts would result from the general increase in the value of land due to improved access to the area, thus accelerating development. Development of offices, light manufacturing, research labs, hotels, and condominiums is already occurring and/or is planned, and the Artery/Tunnel Project is expected to reinforce and strengthen this existing

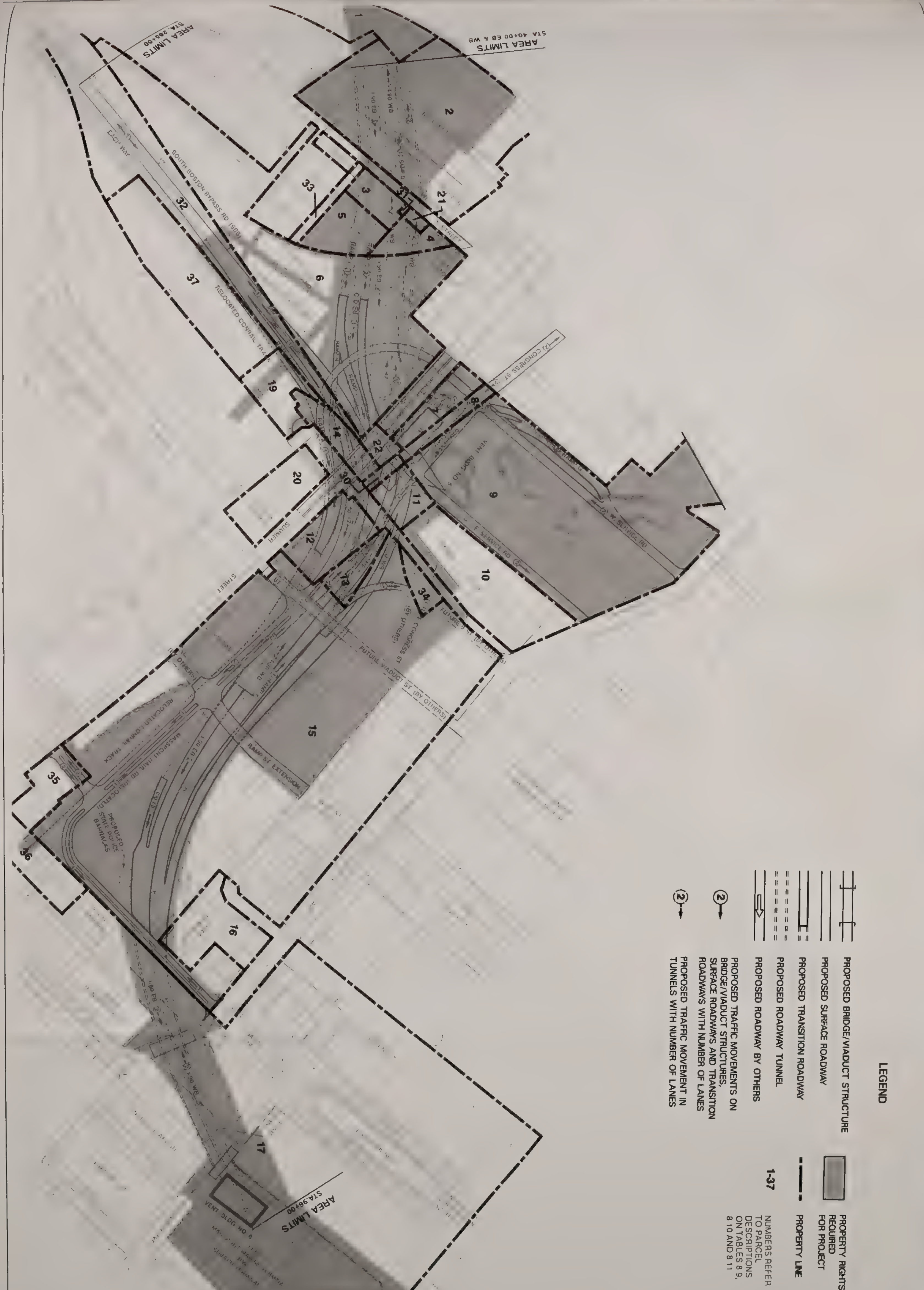


FIGURE 8.19 (a)

Land Use Impacts
South Boston/South Boston Bypass Road (Northern Area)

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CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

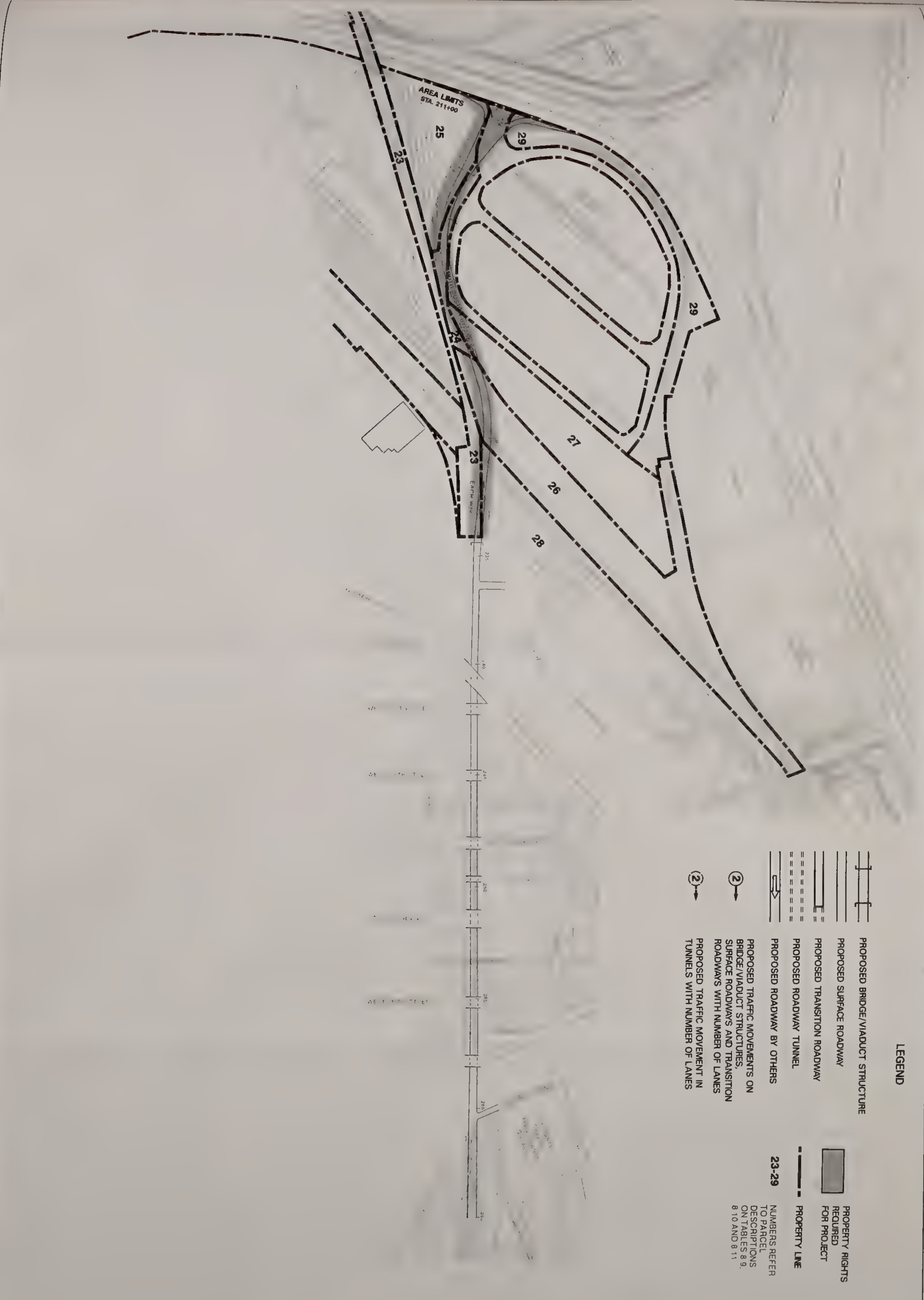


FIGURE 8.19 (b)

Land Use Impacts

South Boston/South Boston Bypass Road (Southern Area)

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

Table 8.9

LAND USE IMPACTS IN SOUTH BOSTON/SOUTH BOSTON BYPASS ROAD AREA

			PERMANENT TAKINGS (approximate SF)				
Property Owner	Current Use	* P/F	Fee Acquis	Under-ground Hwy Easement	Overhead Hwy Easement	Acquis Type* Presently Uncertain	Impacts/Mitigation
The Gillette Co	See Table 8.8, #4	P		84,100			
The Bstn Wharf Co	Prkg	P		148,000			Future dev will be restricted over tunnel box; mitigation under disc
Comm of MA (MDPW)	Prkg						No long-term impacts
Slade Gorton Co	Seafood processing	F	14,500				Existing bus to rcv relo benefits
M. Leonard Lewis	Prkg	F		31,000			Future dev may be restricted; mitigation under discussion
US Postal Svc	Prkg	P				257,400	Loss of 392 prkg sp & potential dev of site will be restricted; mitigation under disc re ability to provide replacement prkg
Broderick Northern Rlty Trst	Vacant/prkg	F	49,407				Future vent bldg site; bus entitled to relo benefits; loss of 25 prkg spaces
Owner unknown	Cong. St (priv way)	F	39,946				Cong. St to be relocated
The McCourt Co Inc	Vacant	P	222,450				Impacts to potential development due to infrastructure imp's
NE Seafood Ctr Assn	Seafood processing	P	200				No impacts to existing ops
NJ & KN Contos	Vacant/prkg	F	31,099				Future vent bldg site; loss of 124 prkg spaces; bus entitle to relo benefits
Comm of MA (MDPW)	Leather bus						Previous owner relocated
Comm of MA (MDPW)	Hoisting equip bus						Previous owner relocated
No Name Restaurant Inc	Vacant/prkg	F	Taken-part of SBHR				Bus entitle to relo benefits
Massport	Mixed use	P				504,300	See Table 8.10
Fishery Products, Inc	Seafood processing	P		2,300			Measures to preserve bldgs, access & bus rqmts to be determined
EDICorp	Mixed office indus	P	66,800	240,400			See Table 8.11
Consolidated Rail Corp	RR freight ops	P	37,500				No impacts to RR ops
NJ Contos	Vacant	F	6,200				Parcel to be used for proj ROW
MP Starvis, Trstee of Fargo Rlty Trst	Bus	P	600	100			Portion bldg to be demolished; mitigation under discussion
Bianchi Assocs	Clothing manuf	F	7,361				Bus entitled to relocation benefits
NJ & KN Contos	Vacant/prkg	F					Fut vent bldg site; Prkg bus entitled to rel benefits
Natl RR Passenger Corp	RR ROW	P	13,500		2,000		No impact to RR ops

Table 8.9 (Cont.)

LAND USE IMPACTS IN SOUTH BOSTON/SOUTH BOSTON BYPASS ROAD AREA

				PERMANENT TAKINGS (approximate SF)				
Parcel No.	Property Owner	Current Use	* P/F	Fee Acquis	Under-ground Hwy Easement	Overhead Hwy Easement	Acquis Type* Presently Uncertain	Impacts/Mitigation
24	Natl RR Passenger Corp	RR ROW	P			15,500		No impact to RR ops
25	Natl RR Passenger Corp	RR car storage	P	21,100		2,700		No impact to RR ops
26	Natl RR Passenger Corp	RR ROW	P			18,400		No impact to RR ops
27	MBTA	Trackage ROW	P			11,100		No impact to RR ops
28	MBTA	RR ROW (Cabot Yd)	P	7,500				No impact to RR ops
29	New Bstn Food Mkt Dev	RR ROW	P	10,000				Access rd to be relocate
30	Owner unknown	Cong. St (priv way)	F	15,493				Cong. St to be relocatec
31	House of Bianchi Inc	Prkg/dumpster	F	1,486			400	Bus entitled to reloc be
32	Conrail	RR ROW	P				•	No impact to RR ops
33	Owner unknown	Wormwood St (priv)	P		900			No impact
34	Bstn Edison Co		P				•	Impact uncertain @ thi
35	USA	Prkg	P				•	Loss of 151 prkg spaces tion under discussion
36	USA	Prkg	P				•	Existing rail to be realig
37	NJ & KN Contos	Vacant	F					To be transferred to Co RR ops
38	Owner unknown	Passageway (priv)	P	6,500				Passageway closed
39	Boston Wharf Co BS&G	Business	P		300			Building corner underp impact to continued use

* Uncertain at this time whether area noted will be a taking in fee or an underground/overhead highway eas Extent of acqusition [partial (P) or full (F)] also uncertain at this time.

Source: Bechtel/Parsons Brinckerhoff

Table 8.10

LAND USE IMPACTS ON MASSPORT PROPERTY

Building/Business	Type of Business	Impact/Mitigation
South Boston (Commonwealth Flats)		
1. Pappas Building	Office/mfg/warehouse	Loss of 62 parking spaces; 11 businesses to receive relocation benefits
2. Commercial Union Insurance	Shipping/warehouse/printing	Loss of 46 parking spaces; business to receive relocation benefits
3. Turner Fisheries	Fish processing	Loss of 27 parking spaces; other impacts uncertain at this time
4. Massport	Parking	Loss of 105 parking spaces
East Boston (Logan Airport)		
1. Eastern Air Cargo Building	Cargo/freight forwarders	3 businesses to receive relocation benefits
2. Hill Cargo Building	Cargo/office/freight Forwarders	5 businesses to receive relocation benefits
3. North Cargo Building	Cargo/office	12 businesses to receive relocation benefits
4. National Car Rental	Car rental	Business to receive relocation benefits
5. Citgo Service Station	Service station	Business to receive relocation benefits
6. United Air Flight Kitchen	Catering	Business to receive relocation benefits
7. Eastern Airlines Hangar	Airline hanger	Business to receive relocation benefits
8. Alamo Rent-A-Car	Car rental	Business to receive relocation benefits
9. Cargo-Trex Building	Freight forwarders	3 businesses to receive relocation benefits
10. Eastern Airlines Fuel Farm	Fuel farm	Business to receive relocation benefits
11. Van Deusen/Pan Am Fuel Farm	Fuel farm	Business to receive relocation benefits
12. Hilton Hotel	Hotel	May require some access modifications
13. Electric plant	Electric plant	Will be relocated
14. Sewage lift station	Lift station	Will be relocated
15. Electric substation	Substation	Will be relocated
16. Bus/limo pool	Transportation	Functional restoration
17. Helipad	Helipad	Functional restoration
18. Employee Parking Lot B	Parking	Functional restoration
19. Secure corridor	Security	Functional restoration
20. EAL Reservations Parking	Parking	Loss of some parking spaces
21. Delta Reservations Parking	Parking	Some loss of parking
22. Service Road	Transportation	Will be realigned
23. Harborside Drive	Transportation	Will be realigned
24. Access/egress roads	Transportation	Will be realigned
25. Pan Am Cargo	Cargo	Vehicular entranceway will be modified
26. Construction gatehouse	Security	Functional restoration

Source: Bechtel/Parsons Brinckerhoff

Table 8.11

LAND USE IMPACTS ON EDIC PROPERTY

Building/Business	Type of Business	Impact/Mitigation
1. Towle Manufacturing	Manufacturing	Long-term use of building may be affected; mitigation under discussion
2. Nagle Seafood	Seafood processing	Long-term use of building may be affected; mitigation under discussion
3. Subaru	Parking lot	Vent building and parking will occupy less than 1 acre of site
4. General Ship	Steam plant	Plant to be replaced in another location

Source: Bechtel/Parsons Brinckerhoff

trend, rather than cause changes in land use patterns. The Proposed Action is consistent with the BRA's Draft 1989 Fort Point District Plan which establishes goals for the New Congress Street/Piers Enterprise Zone, an Industrial Study Area, and the St. Vincent's Residential Area.

Neighborhood: The South Boston community will benefit from the South Boston Bypass Road which will remove through truck traffic from residential streets. This new road will be constructed in an existing railroad right-of-way. Neither neighborhood boundaries nor cohesion will be affected.

Particular issues of concern for the South Boston community are truck traffic, access to the waterfront, and future development. Design modifications have been made to address these concerns (see Comparison with FEIS/R).

Noticeable impacts to residential areas are not expected from the proposed ventilation building at Congress and B Streets due to the considerable distance between these streets and the new facility.

With the exception of Flaherty Park which will experience increased noise impacts, alongside the Bypass Road right-of-way, community facilities within the South Boston neighborhood will be unaffected by the Proposed Action. No school facilities or activities will be affected by the Proposed Action. [Impacts to and mitigation measures for Flaherty Park are discussed in the Section 4(f) Evaluation in Part III of the SEIS/R.]

8.2.8(e) East Boston/Logan Airport Area (See Figure 8.20 and Tables 8.10 And 8.12)
East Boston.
Land Use: Most of the proposed construction activity in the East Boston area will occur on Massport property. In non-Massport areas, a portion of the southern edge of the East Boston Memorial Stadium Park will be extended, expanding the park and providing a better pedestrian connection to the neighborhood via Porter and Bremen Streets (see Figure 8.21). The existing overhead ramps into the airport on the southwest corner of the park will be removed and replaced northeast of the park [see Section 4(f) Evaluation in Part III of the SEIS/R]. The Airport MBTA Blue Line station will be rebuilt to allow for rail-shuttle bus transfers at the same level and improved pedestrian connection to East Boston.

Secondary impacts may result from the increased attractiveness of undeveloped or underused parcels in East Boston for residential and related retail development. A number of proposals for this type of development already exist, independent of the Artery/Tunnel Project.

Neighborhood: Improved traffic flow at Logan Airport and at the Callahan/Sumner Tunnels resulting from the project will help to reduce traffic on local East Boston streets. Traffic from the South Shore will reach Logan Airport via the Third Harbor Tunnel, reducing the amount of traffic that goes through East Boston before reaching the airport. Reduced congestion, improved access to downtown Boston, and improved air quality will enhance the overall quality of life for residents of this neighborhood. With the expansion of East Boston Memorial Stadium Park, neighborhood boundaries and neighborhood cohesion will be improved. Removal of the ramps into the airport from the southwest side of East Boston Memorial Stadium Park will achieve an upgrading of aesthetics and recreation facilities for the community.

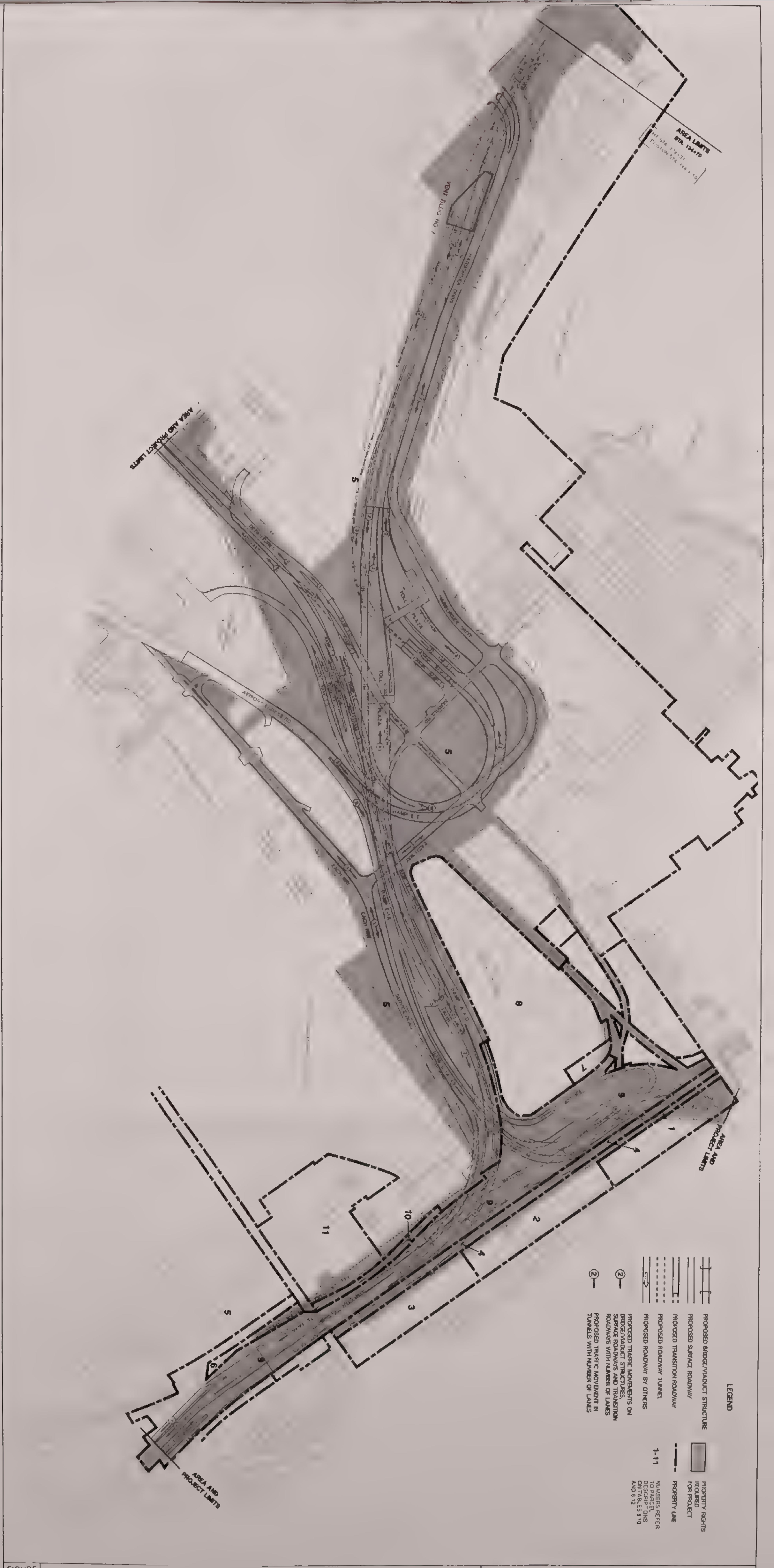
Table 8.12

LAND OWNERSHIP IN EAST BOSTON/LOGAN AIRPORT RIGHT-OF-WAY

			PERMANENT TAKINGS (approximate SF)					
Parcel No.	Property Owner	Current Use	* P/F	Fee Acquis	Under-ground Hwy Easement	Overhead Hwy Easement	Acquis Type* Presently Uncertain	Impacts/Mitigation
1	Ciampa Rlty Corp	Air freight	P			13,200		Future use of parcel rest overhead ramps; loss of spaces
2	R Goldberg, Trstee of AJ Breman Rlty Trst	Park & Fly	P	35,400				Loss of 18 pkg spaces; bu can continue to operate
3	R Goldberg, Trstee of AJ Breman Rlty Trst	Park & Fly	P	16,000				Loss of some pkg space; above; business can cont to operate
4	Consolidated Rail Corp., MJ Bloom, TP Desloge Jr, R Goldberg & D Levin, Co-Trstee (easement holder)	Rail ops Park & Fly	P	117,500				Loss of some parking an billboards area; business continue to operate
4a	R. Goldberg, Trustee Logan Communications Trust (airspace)	Billboard	P (see Pcl.4)					Relocation of some billb necessary
5	Massport	Airport ops	P		479,200		1,290,800	See Table 8.10
6	Massport		P		15,500			See Table 8.10
7	City of Bstn	Playground	P					Removal of viaduct on so will allow for park expans better access
8	City of Bstn	Playground	P					See #7 above
9	MBTA	Rapid transit ROW	P	22,600				No impact on ops; track relocated; improved trair transfer
10	Comm of MA (MDPW)							No change in use
11	RSR Rlty Co Inc	Mixed	P	32,700				Five businesses to receiv relocation benefits

* Uncertain at this time whether area noted will be a taking in fee or an underground/overhead highway easement. Extent of acqusition [partial (P) or full (F)] also uncertain at this time.

Source: Bechtel/Parsons Brinckerhoff



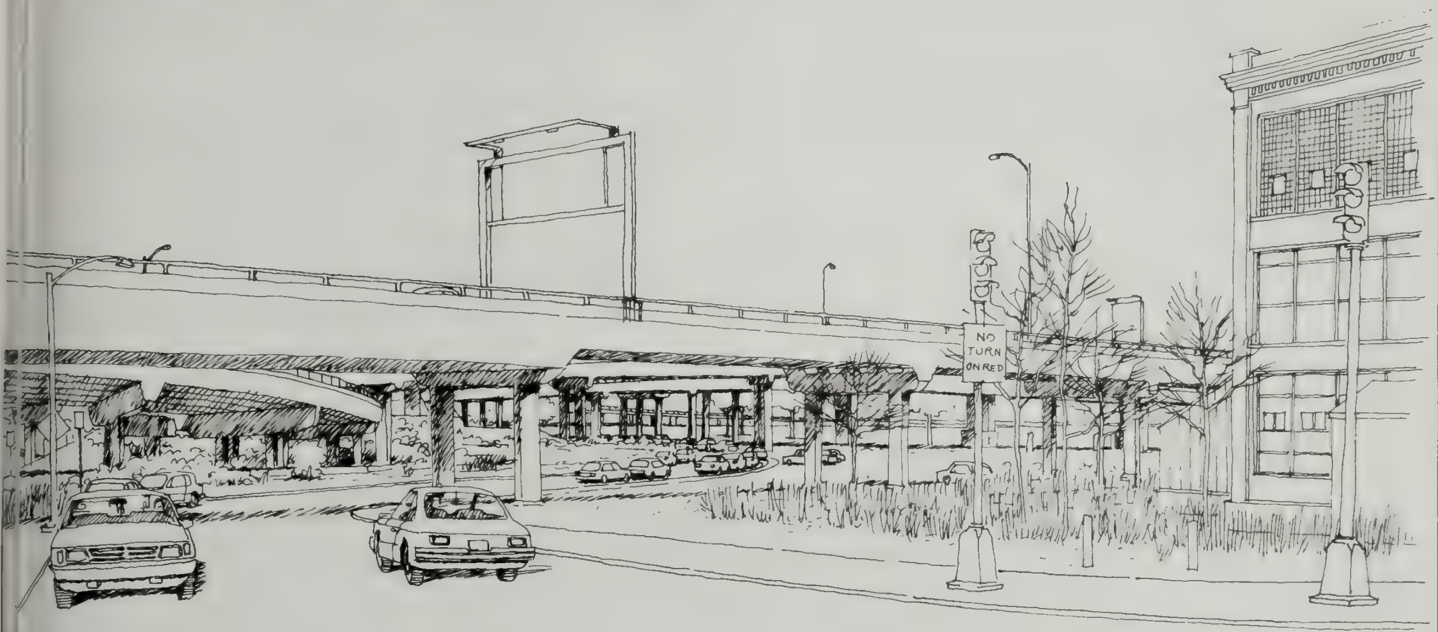
FIGURE

8.20 **Land Use Impacts**
East Boston/Logan Airport Area

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

0 100 200 400 800 Feet

Existing Porter Street entrance to East Boston Memorial Stadium.



With removal of viaduct, the park can be expanded. The new entry provides more direct and inviting access to pedestrians.

IGURE 8.21

Perspective Of Expanded East Boston Memorial Stadium

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

The Massachusetts Turnpike Authority is investigating depressing the existing Sumner/Callahan Tunnel portals in East Boston. This effort is not a part of the Proposed Action, although it will not be precluded by the project alignment.

Proposed ventilation building 7 (near the Massachusetts Technology Center at the tip of Bird Island Flats) and the toll plaza on airport property, both relatively far away from the East Boston neighborhood, will not affect them.

Ramp revision in the area of Route 1A will result in improved community access to the MBTA station, but may require acquisition of all or part of a park-and-fly facility to provide for interim access and a buffer area.

Logan Airport.
Land Use: Long-term impacts to Logan Airport will be beneficial as improved highway connections will reduce traffic tie-ups on airport property. Specific land use changes will include construction of a toll administration plaza, emergency response vehicle garage, traffic enforcement center, and a ventilation building on Bird Island Flats. These facilities will not interfere with proposed developments in the area by Massport and its tenants.

Neighborhood: This is not a residential area. (See East Boston discussion for the related neighborhood impacts.)

8.3 MITIGATION MEASURES

Alignment modifications have been made since the FEIS/R to minimize negative impacts. Where relevant, site-specific mitigation measures are noted in Tables 8.6 through 8.12. Because of the limited number of adverse land use impacts, few land use mitigation measures are required for the Proposed Action. In those cases where highway ramps at the edge of newly created air rights parcels complicate the potential for joint development of those parcels, designs will be developed which provide a means of attaining desired land use goals by including ramps within building envelopes or screening them with appropriate landscaping.

For parcels where access has been impeded, alternative means will be provided. For parcels where the impact requires acquisition by the project, tenants will be relocated. (See Conceptual Relocation Plan Appendix. The replacement of parking spaces acquired by the project is discussed in Chapters 3 and 20, and in the Transportation Appendix.)

Extensive mitigation measures are recommended in the Area North of Causeway Street, however, due to adverse land use impacts of the Proposed Action structures. These measures are highlighted here. For further details, see the Section 4(f) Evaluation in Part III of the SEIS/R.

The south bank portion of the Paul Revere Landing Park not permanently used by the Proposed Action will be restored after construction. The reconfiguration that will occur in this area will maintain previous park functions and enhance them, as 73 parking spaces will be displaced. On the north bank, the park will be expanded north and west to the CANA ramps and new bridges, and replanted as a major element in the riverfront park system, connected by landscaped walkways through the Chapter 91 area and to Charlestown.

An attractive pedestrian environment will be developed on the east and north sides of the Charles River bridge transition section and abutment between Paul Revere Landing Park (south bank) and Causeway Street. Access on the west side of the bridge abutment will be determined in coordination with developers of the new Boston Garden.

A small urban plaza marking the entrance to Paul Revere Landing Park will be constructed as a part of the Proposed Action above the Causeway Street portal of the Central Artery tunnel.

A pedestrian walkway and a commuter ferry landing facility will be constructed on Lovejoy Wharf.

The Department will pay for the preparation of an overall master plan and design and contract documents for two major developments essential to the completion of the MDC park system and for the park development of these properties. These are: (1) the Nashua Street parkland which provides a major opportunity for heavy public use of an extended Esplanade; and (2) the former GSA site, which will be major park node on the north bank of the river serving new development in Cambridge and connecting to Paul Revere Landing Park via the improvements in the CANA project Chapter 91 area. Land or easements along the North Point development area, which completes the connection on the north side of the river, may be obtained through the development process, and the Department will provide assistance with park improvements on easements secured by the MDC (see Figure 8.22).

Improvements to Leverett Circle will be provided as a part of the Proposed Action, including landscaping of a larger reconfigured parkland area as well as reconstruction of pedestrian overpasses. Landscaping in the area will be compatible with the Charles River Esplanade ambience and will create an attractive visual terminus to Storrow Drive.

The Proposed Action will achieve the objective of providing positive land use impacts by access and the visual environment and creating joint development opportunities. (Some parcel-specific mitigation measures are discussed in the subarea descriptions in Section 8.2, and they are noted in Tables 8.6 through 8.12.)

8.4 COMPARISON WITH FEIS/R

8.4.1 Area North Of Causeway Street

The alignment of the new Charles River bridge has been shifted further to the west, allowing expansion of the Paul Revere Landing Park westward. Impacts to the river's edge, however, will be increased due to the amount of additional structure. The impacts to the North Point area of Cambridge noted in Section 8.2.1 did not occur in the previous alignment described in the FEIS/R.

The Artery/Tunnel Project has been redesigned to minimize interference with MBTA plans for North Station, the development proposal for the new Boston Garden complex, and proposals for land owned by Massachusetts General Hospital; a detailed coordination process has been organized to accommodate simultaneous construction of some of these projects. In addition, the Proposed Action has eliminated the need for a ventilation building and associated

FIGURE 8.22

Illustrative Parkland Development Concept, Area North Of Causeway Street

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93) TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

takings of parts of the historic Stop & Shop and Charles River Buildings, as described in the FEIS/R. However, design changes to address previous substandard weaving distances (as described in Chapters 2 and 3) have resulted in less convenient vehicular access to the North Station area from the Central Artery. Pedestrian access to the river from downtown has been improved.

In the West End area, the Proposed Action includes a shift in the alignment of the Storrow Drive-Central Artery ramps from alongside the Charles River, as proposed in the FEIS/R, to alongside Martha Way and behind Boston Garden (see Chapter 2). This shift was made to support park expansion plans of the MDC, and to reduce filling in the Charles River. The Storrow Drive/Central Artery ramps will be in an existing transportation corridor; therefore, long-term impacts should not be substantially different from current conditions.

8.4.2 Central Area

Design changes near the North End will improve pedestrian access materially. Grade-separating the Sumner/Callahan Tunnel entrances will provide for easier, more direct pedestrian access between the North End and Haymarket, and improved pedestrian and vehicular access across the area now occupied by the Sumner/Callahan Tunnel portals. Open boat ramps, which limit the development potential of adjacent parcels, have been moved north to ensure that development parcels in the North End and near the Blackstone Block are free from those constraints. However, this modification may limit or preclude development on the portion of the Central Artery right-of-way in front of the Government Center Garage at New Chardon Street.

Long-term land use impacts of the Atlantic Avenue alignment on the downtown waterfront area are not expected to be substantially different from the Fort Point Channel alignment presented in the FEIS/R. However, the changes have resulted in specific benefits. Pearl Street will be extended easterly to intersect with Atlantic Avenue, improving surface street traffic flow.

8.4.3 I-93/I-90 Interchange And Massachusetts Avenue Interchange Area

The major project changes since the FEIS/R that will affect Chinatown include the partial rebuilding of the Dewey Square tunnel, the closing of the Beach Street ramp, and the eastward relocation of the I-93 southbound on-ramp. These changes will provide greater benefits to Chinatown through elimination of impacts to Pagoda Park, reductions in traffic in the heart of the neighborhood, and an increase in new, developable land adjacent to Hudson Street and near Beach Street.

Although northbound I-93 lanes have been moved from Fort Point Channel to Atlantic Avenue, immediately adjacent to the Leather District, the new road will be in tunnel and thus will not affect that district. Surface streets will continue to operate much as they do now.

The most substantial project change in this area since the FEIS/R is the extension of project limits southerly to include the Massachusetts Avenue interchange area. No adverse impacts on neighborhood facilities are expected due to this modification. Through coordination with the City of Boston, EDIC, and other development proponents in the area, the Proposed Action has been designed to support the needs of the South Bay/Newmarket area, one of Boston's few remaining industrial districts.

8.4.4 South Boston And South Boston Bypass Road Area

Design modifications have been made to minimize the impact of the Proposed Action on the neighborhood. The South Boston Bypass Road, not included in the FEIS/R alternatives, will reduce truck traffic on local streets. Access to the waterfront will be maintained, and a greater portion of the new Seaport Access Road will be in tunnel rather than open, depressed roadway. The current shift to the north of the Seaport Access Road tunnel alignment will retain options for future development in the area, particularly along Summer Street. This shift is in accordance with the City's plan for Summer Street to be a major, pedestrian-compatible arterial. The alignment has been shifted east to the Subaru Terminal to eliminate the impacts to General Ship; this modification will preserve a number of jobs in the area.

8.4.5 East Boston/Logan Airport Area

Design modifications in the Artery/Tunnel Project have upgraded expected benefits for the East Boston community. Removal of the surface and elevated airport access ramps, which currently separate the neighborhood from East Boston Memorial Stadium Park, will reconnect this important community facility with the residential area, making access more convenient and allowing park expansion. The Proposed Action also includes improvements to the MBTA Blue Line Airport station.

Changes since the FEIS/R include relocating the toll plaza and related facilities from South Boston to Bird Island Flats. Other changes include relocating the ventilation building to a site behind the Massachusetts Technology Center to avoid impacts to that building, and shifting the existing airport access ramps to the northeast side of the East Boston Memorial Stadium Park.

The Route 1-A connections involve changes to accommodate the MBTA Airport station and East Boston Memorial Stadium Park and may involve acquisition of the Park and Fly facility to provide the interim construction routes and a possible buffer area for the neighborhood.

8.5 RESOLUTION OF ISSUES RAISED BY PUBLIC AGENCIES

A more detailed description of the impacts of the Charles River crossing was requested by DEP, MDC, Cities of Boston and Cambridge, and the Charles River Watershed Association. The text was expanded. In addition, the Alternatives Analysis for the Area North of Causeway Street in Part II and the Section 4(f) Evaluation in Part III of this SEIS/R provide further (separate and specific) discussion of issues in this area and resolution of them.

A more detailed discussion of existing conditions and land use impacts in Cambridge was requested by the MAPC and Cities of Cambridge and Boston. The text was expanded.

Concern over impacts to Haymarket operations was expressed by the City of Boston. The text was revised to include the potential impacts and mitigating measures to ensure continued operation.

A more detailed description of the impacts of new ramps, open boat sections and surface streets was requested by the City of Boston. The discussion of these impacts has been expanded.

The inclusion in the Proposed Action of the proposed new Turnpike ramps at East Berkeley and Arlington Streets and the depression of the Sumner/Callahan Tunnel portals in East Boston was requested by the City of Boston. The text was revised to indicate that although the Proposed Action would not preclude these two projects, they are Massachusetts Turnpike Authority projects and not part of the Proposed Action.

A description of the potential impacts of a range of joint development options was requested by EPA. The text was revised to indicate that individual joint development projects will be subject to separate environmental documentation processes at a later date. The range of development will be determined by the joint development process; therefore, potential impacts cannot be evaluated at this time.

Chapter 9 – Visual Characteristics

Chapter 9
VISUAL CHARACTERISTICS

This chapter describes the changes in the visual environment since the FEIS/R was written in 1983 and potential changes to the visual environment because of the Proposed Action. The Proposed Action's major visual benefit results from removing the existing Central Artery viaduct structure and allowing for the future development of the newly created surface parcels above the proposed Central Artery tunnel. In place of the Central Artery's "ugly green monster" viaduct, the opportunity to reconnect neighborhoods now severed physically and visually by the structure will be created. Major improvements in the Artery/Tunnel Project design since the FEIS/R include moving the Charles River bridges west, away from the Charles River dam locks and Charlestown's City Square, and eliminating the tunnel and boat sections along the south bank of the Charles River. Another major alignment change is the relocation of the airport access road to the northeast side of the East Boston Memorial Stadium Park, minimizing its impact on the park. These design improvements have important visual benefits.

9.1 AFFECTED ENVIRONMENT

In general, the visual characteristics in most of the project area have not changed substantially since the FEIS/R. New developments that have altered the visual environment are: (1) the construction site of the Department's Central Artery North Area (CANA) Project in Charlestown (I-93/Route 1 interchange); and (2) downtown Boston's large new development projects such as Rowes Wharf and International Place. In addition, the project right-of-way has been enlarged to include the South Boston Bypass Road and the Massachusetts Avenue interchange areas. These areas were not described in the FEIS/R.

The visual characteristics of the Artery/Tunnel Project study area are varied. The Central Artery segment follows the path of the existing facility through a tightly knit and historic urban fabric. In the Area North of Causeway Street, the Artery spans the Charles River and circles around a large open area of underdeveloped and industrial land. The Southeast Expressway, Seaport Access Road, and Logan Airport segments follow a new right-of-way flanked by large-scale low-rise developments on large parcels, and open areas such as those at Logan Airport. The following sections describe the overall visual environment of the study area, concentrating on the new developments built since the FEIS/R and encompassing the enlarged project area.

9.1.1 Area North Of Causeway Street

The overall visual character of this area today is dominated by the aging steel roadway viaducts, railroad yards, a sand and gravel plant, and parking lots at grade (see Figure 9.1). The CANA project in Charlestown will improve the visual environment of City Square by replacing much of the Route 1 highway viaduct structure in the area with a tunnel. The visual environment in the project area in Cambridge is formed primarily by industrial and transportation facilities.

In this area, the Central Artery crosses the Charles River on a two-level bridge. The height of the bridge provides motorists in both directions with views of Charlestown, Cambridge, Boston, and Boston Harbor. Southbound, the distant downtown Boston skyline provides an orientation to the City.

The pedestrian environment at grade is dominated by the overhead highway and structural supports, vehicle noise, and pigeons. The highway structure and parking lots block the views of the river and the Paul Revere Landing Park along both sides of the river from Causeway Street.

Close to the river, an interesting but disorganized urban vista is formed by a succession of elements. On the north bank are the curving viaduct carrying I-93 north of the Charles River, the Millers River, and the Boston Sand & Gravel facilities. On either side of the riverbanks are granite bulkheads. At each end of the new Charles River dam are found the landscaped areas of the Paul Revere Landing Park. Spanning the river are the MBTA's bascule commuter railroad bridge, and the Central Artery's granite piers, sculptural trusses, and K-braces.

The area between the Charles River and the viaduct connecting the Central Artery to Leverett Circle is predominantly a vast expanse of parking lots and commuter railroad facilities which block river views and its interesting vistas. These conditions, however, will change substantially in the near future. The area south of the viaduct is the site of the future realigned Green Line subway and the new Boston Garden complex, which will create a very active and attractive pedestrian area. The area north of the viaduct is the site of future development by others.

On the river between the old and new Charles River dams, boaters have views of industrial land to the north and a combination of railroad facilities, parking lots, and North Station to the south. The river is seen as a water sheet approximately 400 feet at its widest, with the existing narrow high-level bridge passing approximately 50 feet overhead. The river's edge is primarily a bulkhead or a grassy neglected area, except at the Paul Revere Landing Park.

Drivers passing through Leverett Circle have views of the Charles River Park apartment towers to the southeast, and the Charles River, the Charles River Esplanade, and the Green Line viaduct to the northwest. More distant views to the north are of the Massachusetts Registry Building and the recently completed new jail. The center of Leverett Circle (a traffic rotary) is landscaped, with the elevated MBTA Science Park Green Line station overhead.

9.1.2 Central Area

The Central Area (see Figures 9.2, 9.3, and 9.4) contains three distinct visual zones with respect to building mass, height, and street pattern. The three zones are: Causeway Street to State Street, State Street to Congress Street, and Congress Street to Kneeland Street. The Central Artery is on a viaduct in the first two zones and in a tunnel in the third.

The Central Artery viaduct provides motorists with different views of buildings, monuments, and the Harbor. Many of these views are pleasant and help orient motorists. Others are of

A. Aging steel structures and parking lots near Paul Revere Landing Park.

B. Southbound motorists view of Boston Sand and Gravel and Downtown Boston in the distance.

C. Central Artery Bridge crossing Charles River.

D. Southbound motorists view of Downtown Boston with the Custom House Tower in the center.

E. Bottom of viaduct is 40 feet above Beverly Street next to Anelex Building.

F. Area south of Charles River is used for parking.

FIGURE 9.1

Visual Characteristics
Area North of Causeway Street

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

A. Low-rise buildings near Faneuil Hall create a comfortable pedestrian environment.

B. View of Salem Street from Cross Street in the North End.

C. Southbound motorist's view looking down State Street with the Custom House Tower and State House.

D. Southbound motorist's frontal view of Downtown Boston with the Custom House Tower in the center.

E. The ramps to and from the Central Artery form walls that are largely impenetrable.

F. BRA view corridor looking at the North Church steeple from City Hall Plaza.

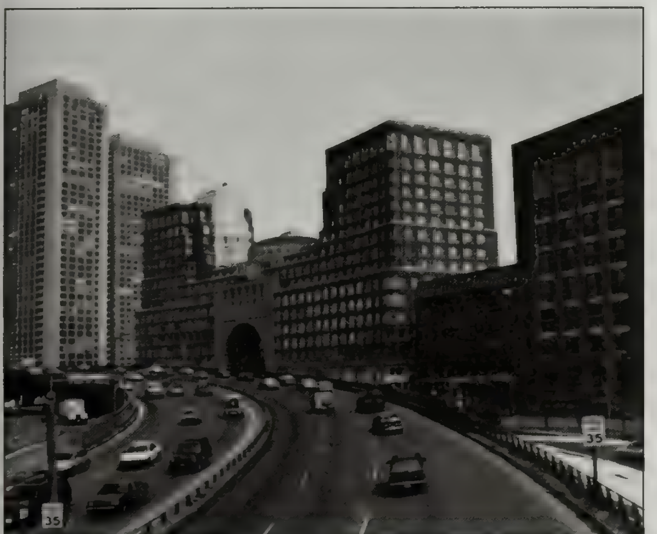
FIGURE 9.2

Visual Characteristics
Central Area

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

A. The Grain Exchange Building is dwarfed by the Artery. The Custom House Tower is beyond.

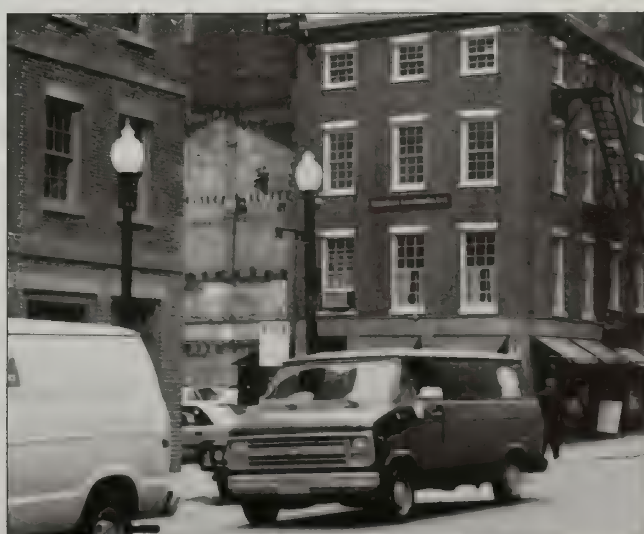
B. View through the arch of Rowes Wharf Building at the Custom House Tower, interrupted by the Central Artery viaduct.



C. Northbound motorist's view of Harbor Towers and Rowes Wharf.

D. Southbound motorist's view of Russia Wharf, the Federal Reserve Building, South Station and One Financial Center.

E. The view underneath the Central Artery viaduct.



F. View of the historic Broad Street district.

FIGURE 9.3

Visual Characteristics
Central Area

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

A. Beach Street in Chinatown with first-floor restaurants and shops

B. South Street in the Leather District.

C. Motorist's view of the Financial District from northbound Surface Artery.

D. The Chinatown gate and Chinatown beyond viewed by northbound surface motorists.

E. Northbound motorist's view of the edge of the Financial District and Rowes Wharf beyond.

F. Dewey Square - view from South Station.

IGURE 9.4

Visual Characteristics
Central Area

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

truncated portions of buildings (cut off during construction of the viaduct in the 1950s) which represent disorienting elements.

9.1.2(a) Causeway Street To State Street

For the pedestrian, the Central Artery viaduct structure is a major visual and physical barrier disrupting sightlines and creating awkward movement patterns. The ramps to and from the Central Artery form walls that are difficult to penetrate in the area of the North End and the Bulfinch Triangle. The east side of the Artery is lined with four- to six-story red brick commercial buildings in the North End, followed by Christopher Columbus Park, the Walk-to-the-Sea (pedestrian way), and views to the Harbor. The west side traverses the older brick industrial buildings of the Bulfinch Triangle and the active Haymarket and Faneuil Hall Marketplace historic buildings. The surface road system is impassable in front of the Callahan Tunnel entrance and Sumner Tunnel exit at most times for both pedestrians and automobiles and is visually confusing. The width and the low clearance of the viaducts of the Central Artery create a dark and noisy street-level environment. However, thousands of people daily pass under the Central Artery and across the busy Surface Artery and Atlantic Avenue in several locations to reach Columbus (Waterfront) Park, the Aquarium, the Rowes Wharf water transit terminal, and the North End.

9.1.2(b) State Street To Congress Street

The scale and character of the buildings vary between new high- and mid-rise buildings and older four- to six-story brick structures. Views from side to side are framed or blocked by the Artery structure at all cross streets. An important new addition in this area is the Rowes Wharf complex with its giant arch, providing a potential visual corridor between the Harbor and Broad Street district, which is interrupted today by the Central Artery viaduct. Other changes in the visual environment include the 600-foot-high International Place and the 125 High Street complex now under construction, which will be over 400 feet high. Phase II of International Place will include a relocated southbound Central Artery off-ramp to Purchase Street.

Southbound and northbound motorists have equal opportunities to experience wide views in this area. For northbound motorists the Dewey Square tunnel portal acts as a very important and impressive visual gateway from the south to downtown Boston and the waterfront area.

The views available to motorists on the elevated Central Artery contrast sharply with the pedestrian environment beneath it. Pedestrians can walk under the Central Artery, where the full adverse effect of the elevated highway structure is experienced. The area is very dark, its low height limits views of adjacent areas, pigeons roost in the structure above, and the noise of overhead traffic reverberates at the pedestrian level. The columns supporting the viaduct structure seem slender from a distance, but are large enough to encumber circulation and view corridors. The recent sidewalk and paving improvements under the Artery (repainted in this area only) between High Street and Rowes Wharf improve the pedestrian environment.

From High Street to Congress Street, the Central Artery forms a major visual barrier between the Financial District and the Fort Point Channel area. It is first seen as a wall, and then becomes a wide depressed roadway before descending into the Dewey Square tunnel. Views toward the water from High, Oliver, and Pearl Streets end abruptly.

Looking at the Central Artery, the pedestrian on Purchase Street or Atlantic Avenue sees a stream of vehicular traffic and a concrete/steel wall north of Northern Avenue, at which point the view is opened by the roadway descending from viaduct to tunnel. Crossing between Purchase Street and Atlantic Avenue is possible at High Street, along the pedestrian overpass bridge located between the 125 High Street construction site and 470 Atlantic Avenue, and at Congress Street which is at grade. The orientation of many of the older buildings on Purchase Street is to streets that are perpendicular to the Central Artery; sidewalks parallel to the Central Artery are, therefore, devoid of amenities and street-level activities. From Atlantic Avenue, pedestrians and drivers have views of the red Hook Lobster Building and the old Northern Avenue and Congress Street bridges.

9.1.2(c) Congress Street To Kneeland Street
In this area the Central Artery is in tunnel. The edge of the Financial District is dominated by new office towers; Dewey Square, a complex intersection with plazas and medians, is surrounded by these new buildings. The historic South Station serves as the focus of this area. Southwest of Dewey Square is Chinatown which is primarily a residential neighborhood with busy shopping streets characterized by a multitude of colorful signs with Chinese characters. The Leather District, south of Dewey Square and east of the Artery, is a designated historic district characterized by eight- to eleven-story buildings, most of which are red brick. Pedestrian activity in the Dewey Square area is intense at rush hours and in Chinatown both day and night. Moderate pedestrian activity in the Leather District is substantial only during the business day.

9.1.3 I-93/I-90 Interchange And Massachusetts Avenue Interchange Area

From the south, this project subarea is the major entrance into downtown Boston (see Figure 9.5). Open landscaped highway infields and a number of curving highway ramps are the predominant visual characteristics. Drivers continue on to surface streets at this point or enter the Dewey Square tunnel portal. Coming from the north, drivers exiting the Dewey Square tunnel view Chinatown to the west and industrial and highway structures to the south.

There is virtually no pedestrian activity in this area dominated by the I-93 roadways because there are no walkways along the roadways.

9.1.4 South Boston And South Boston Bypass Road Area

South Boston can be divided into three visually distinct areas: the northern industrial waterfront, the EDIC industrial park, and the Fort Point Channel area. The northern area is generally an industrial waterfront district characterized by large buildings and undeveloped areas (see Figure 9.6). The BRA, Massport, the U.S. Postal Service, and several private companies plan major developments here that will change the prevailing industrial visual character by adding large-scale office and mixed use projects. Drivers and pedestrians on Northern Avenue are surrounded by large parking lots and older buildings with Harbor views.

The new Northern Avenue bridge (now under construction) over Fort Point Channel and a realigned Northern Avenue should provide even more impressive views of downtown Boston in the future. Massport, which owns much of the property south of Northern Avenue, has development plans which include a large parking garage to replace surface parking between Summer Street and Northern Avenue. The BRA has plans to extend Congress Street easterly

A. Landscaped infield area with curving ramps.

B. Rapid Service Press Building and the historic railroad bridge over Fort Point Channel.

C. Guardrails diminish views from automobiles.

D. One Financial Center, Boston Thermal and the Wang Building viewed from the south.

E. Hancock Tower in the Back Bay to the west.

F. The wall on Hudson Street looking north next to Chinatown.

IGURE 9.5

Visual Characteristics
I-93/I-90 Interchange And Massachusetts Avenue Interchange Area

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

A. View towards Dewey Square from Summer Street.

B. View of Financial District from Congress Street in South Boston.

C. Looking west toward Downtown from Northern Avenue.

D. View of World Trade Center from Viaduct Street.

E. View of parking lot south of Northern Avenue.

F. Existing railroad tracks and procession of bridges in the proposed Bypass Road Area .

FIGURE 9.6

Visual Characteristics
South Boston and South Boston Bypass Road Area

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

(in a boulevard style) between Summer Street and Northern Avenue, and to connect the new boulevard to the proposed Ramp Street Extension.

The northeastern portion of South Boston includes EDIC's Boston Marine Industrial Park, with large old industrial and distribution facilities, and Subaru's large new car storage area on the waterfront.

The Fort Point Channel area is known for its late 19th century brick warehouses. The street grid, building height, materials, and street details make the area's scale relatively comfortable for pedestrians. Views of downtown Boston provide a strong link from the area to the rest of the City. From the water surface of Fort Point Channel, expansive skyline views are offered in all directions.

9.1.4(a) South Boston Bypass Road Area

The South Boston Bypass Road has been added to the Artery/Tunnel Project since the FEIS/R. Therefore, the area through which it will pass was not described in the earlier document. The Bypass Road will be built in an existing railroad right-of-way, the middle portion of which is spatially defined by both a grade separation about 22 feet below street level and 11 stone and steel bridges which span the railroad cut between Dorchester Avenue and Bolton Street. (Three of the bridges are being removed in a separate action by the Department begun in March 1990.) The railroad cut is defined on both sides by granite walls. Pedestrian access is not allowed into the railroad right-of-way. The bridges do provide pedestrian and vehicular links across the cut, which currently is littered. The northern and southern ends of the cut rise to grade through railroad and industrial areas. Views from the Bypass Road right-of-way near the Southeast Expressway end are of the South End and the railroad yards of South Boston. Views from the railroad cut below are of the procession of bridges overhead. At the northeastern end of the right-of-way, distant views of downtown Boston to the west and a more immediate view of the Summer Street bridge (which acts as the northern visual terminus) appear.

9.1.5 East Boston/Logan Airport Area

From the point where the Proposed Action will join the existing airport roadway system, views are of the broad expanse of large-scale airport facilities including structures, parking areas, and roadways (see Figure 9.7). Although most of the Proposed Action will be located on Logan Airport property, it will pass through or be adjacent to four distinct areas: Bird Island Flats, Logan Airport terminal area, alongside East Boston Memorial Stadium Park, and alongside the right-of-way of Route 1A adjacent to Bremen Street.

Pedestrian activity in the Bird Island Flats area is relatively low at present, but is expected to increase following the completion of the proposed Bird Island Flats hotel and office development. The area is flat, open land developed with low industrial/cargo buildings and the new Massachusetts Technology Center office building. While most of the roads in the airport are at grade, visual and pedestrian access across the airport is restricted. Currently, elevated ramps separate East Boston Memorial Stadium Park from the residential community to the southwest, as do the Route 1A viaducts and the MBTA station to the west. Access to the park is possible only by crossing a parking lot near Porter Street and walking under elevated roadways. The neighborhood of older row houses along Bremen Street faces a large parking lot, the MBTA anti-missile fencing, and the Route 1A viaducts.

Today, drivers on Route 1A southbound and from Logan Airport descend from a viaduct to the East Boston toll plaza. The toll plaza is at grade, connects to City streets, and is surrounded by commercial and residential structures. The driver has the experience of being at the edge of an urban neighborhood before entering the two-lane Sumner Tunnel. This area is directly west of the project right-of-way.

9.2 ENVIRONMENTAL CONSEQUENCES

The Proposed Action will have substantial beneficial aesthetic impacts throughout much of the project corridor. Most positive will be the visual impacts in the Central Area. The existing Central Artery viaduct and ramps, which have covered a 22-acre path through downtown Boston and divided neighborhoods, inhibited pedestrian and vehicular circulation, and created an environment of shadows, exhaust fumes, and traffic noise, will be removed. This viaduct will be replaced with a tunnel between Congress and Causeway Streets. The surface over the tunnel will be improved with new surface streets and new parcels of land creating opportunities for a variety of open spaces and buildings.

In addition, other project architectural elements will change the character of the visual environment and alter the aesthetic experience for motorists and pedestrians. These include large amounts of viaduct structure, open boat sections, a new toll plaza, administration facility, and seven new ventilation buildings. North of Causeway Street, three new bridges across the Charles River, one of which is double-decked, will replace the existing high bridge with lower, wider bridge decks. North of the Charles River, multilevel concentric ramps will encircle the commuter railroad tracks, the Boston Sand & Gravel plant, and the Millers River in Cambridge and Charlestown, creating negative impacts on the visual environment.

Special attention will be given to the design and architecture of project elements, including the following: organization, form, and materials used for structures; the materials, colors, and textures of secondary elements (i.e., lights, signs, rails, and barriers); the design of landscaping within the project corridor; and the incorporation of complementary uses. Such attention to design details will provide that the overall visual effect of these project elements on the urban landscape will be minimized.

This chapter concludes with a discussion of mitigation measures and a comparison to the aesthetic impacts presented in the FEIS/R. Related impacts contributing to the aesthetic environment are discussed in Chapters 8 (Land Use), 4 (Air Quality), and 5 (Noise and Vibration), and in the Section 4(f) Evaluation of impacts to parkland in Part III of the SEIS/R.

It is assumed that the aesthetic and visual environment in the year 2010, without the Proposed Action, would be much the same as today. New development may alter the visual environment in specific locations (especially in the South Boston waterfront and key downtown locations), but the overall character of the project area would not change substantially, and the Central Artery viaduct structure, which would have to be redecked, would still be present.

The description of the Proposed Action's visual impacts is organized into the following project elements or visual effects:

A. Vast expanse of the airport viewed from the control tower looking west.

B. View of Mass. Tech. Center, Porzio Park, and the Jeffries Point residential area and downtown Boston beyond.

C. Approaching Logan Airport; control tower in the distance.

D. View of Hilton Hotel showing pedestrian walks.

E. Entrance to Memorial Stadium.

F. View of Memorial Stadium as motorists exit the airport.

FIGURE 9.7

Visual Characteristics
East Boston/Logan Airport Area

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

- o The Charles River bridges
- o Gateways
- o Tunnels
- o The Central Artery corridor
- o Ventilation buildings

(Figure 9.8 shows the location of the illustrations throughout the rest of this section.)

9.2.1 The Charles River Bridges

The new Charles River bridges and the associated interchange north of the river will create a substantial change in the visual environment. The large and complex new interchange will add concentric and somewhat overlapping viaducts to the CANA loop ramp system (under construction as a separate project) and to the I-93 mainline (see Figure 9.9). At their highest, the ramps will be 115 feet above grade at the west edge of the loop next to the Cambridge North Point area. The new river crossing will be lower, wider, and further west of the existing double-decked three-lane bridge. The result will be a very different visual and aesthetic experience for both driver and pedestrian than exists today. (The experience for drivers is described under Section 9.2.2, Gateways; what follows next is a description of the visual experience for pedestrians.)

Impacts of the Proposed Action on the pedestrian environment are described for four subareas: the pedestrian connection from North Station to Charlestown; the north bank of the Charles River; the south bank; and the wider view of the new bridges and viaducts from Charlestown, Cambridge, and other points in the Charles River Basin. (A detailed description of impacts to parkland is in the Section 4(f) Evaluation in Part III of the SEIS/R.)

9.2.1(a) North Station - Charlestown Pedestrian Connection

This pedestrian connection over the Charles River Dam locks is very heavily used today by residents, commuters, tourists, and patrons of Boston Garden, and its use is expected to grow in the future. It connects North Station and Boston Garden to Paul Revere Landing Park and the U.S.S. Constitution in Charlestown. Today the route is shadowed by the overhead presence of the I-93 viaduct, particularly at Causeway Street where pedestrian crossings also conflict with existing I-93 ramps.

In the Proposed Action, the new underground Central Artery will pass under Causeway Street and through the present site of the Anelex building. The Charles River crossing will be in an alignment farther west than the FEIS/R proposal, which allows for expansion of the Paul Revere Landing Park north of the river and reduces the visual impacts of the structures on City Square in Charlestown.

The proposed addition of a ferry slip in the Charles River near the dam at Lovejoy Wharf, combined with the modifications to the MBTA facilities at North Station, will provide a new intermodal transportation center with easy connections between Green and Orange lines, commuter rail, and Harbor ferries. Elimination of the overhead viaduct and the I-93 ramps from Causeway Street will transform this area into an ideal pedestrian environment (see Figure 9.10).

9.2.1(b) North Bank Of The Charles River

Pedestrians on the north bank, in Paul Revere Landing Park, will see upstream views of the MBTA commuter railroad bridge and the historic Lechmere viaduct, framed by the low, wide, closely spaced bridges. However, the interchange's new ramps, large viaduct structure occupying much of the river edge, the bridges and their support columns in the river and on the banks will dominate this view. The pedestrian route under the viaducts, on the proposed pedestrian bridge over the MBTA commuter rail tracks (required in the CANA Chapter 91 License special conditions), and continuing along the river's edge toward Cambridge, will take the pedestrian under a 700-foot-long section of highway and through a forest of columns (see Figure 9.11). Highway structure will dominate the visual and aesthetic experience. The visual quality of that experience will depend upon the final locations and design of columns, viaduct superstructure, ground level materials, pedestrian amenities, lighting, and any uses located under the viaducts.

9.2.1(c) South Bank Of The Charles River

Removal of the high overhead viaduct structure, columns, and crossbracing between Causeway Street and the Charles River will substantially improve views and pedestrian access toward the river from Causeway Street and to the City of Boston from the river. The proposed bridges, lower and wider than the existing bridge, will dominate views along the south bank, and create a visual discontinuity which will tend to divide the river basin into two sections: one between the historic Lechmere viaduct and I-93 southbound, the other between the MDC dam and I-93 northbound (see Figure 9.12). Pedestrians on the south riverbank walking under these new bridges will experience a tunnel-like environment. The river under the bridges also will be in shadow. The quality of the area under the bridges will depend upon uses located there, lighting, pedestrian amenities, and architectural character and details.

9.2.1(d) The Interchange

The general visual impression will be the juxtaposition of many viaducts at different levels and many columns spaced unevenly on different structural grids. The highway viaducts also will encroach upon land designated as the North Point development area in Cambridge and will dominate the views to the northeast from proposed developments in that area. Viaduct columns will be located in and on either side of the Millers River, which will be shaded by the viaduct above. The visual effect will change, depending upon the viewing angle, but from any angle the interchange will form a visual screen or barrier from the ground plane to the uppermost viaduct.

9.2.1(e) The Charles River

The boater's visual experience of the river will be dominated by support piers under three bridge decks which are barely separated, for a distance of up to 700 feet.

9.2.2 Gateways

When the Artery/Tunnel Project is completed, the major highway entrances, or gateways, into downtown Boston and into Cambridge and Charlestown from the south will be very different than at present. These gateways include I-93, Route 1, and Route 1A from the north, the Massachusetts Turnpike and Storrow Drive from the west, and I-93 (the Southeast Expressway) from the south.

FIGURE 9.8

Key Map Of Perspective Drawings

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

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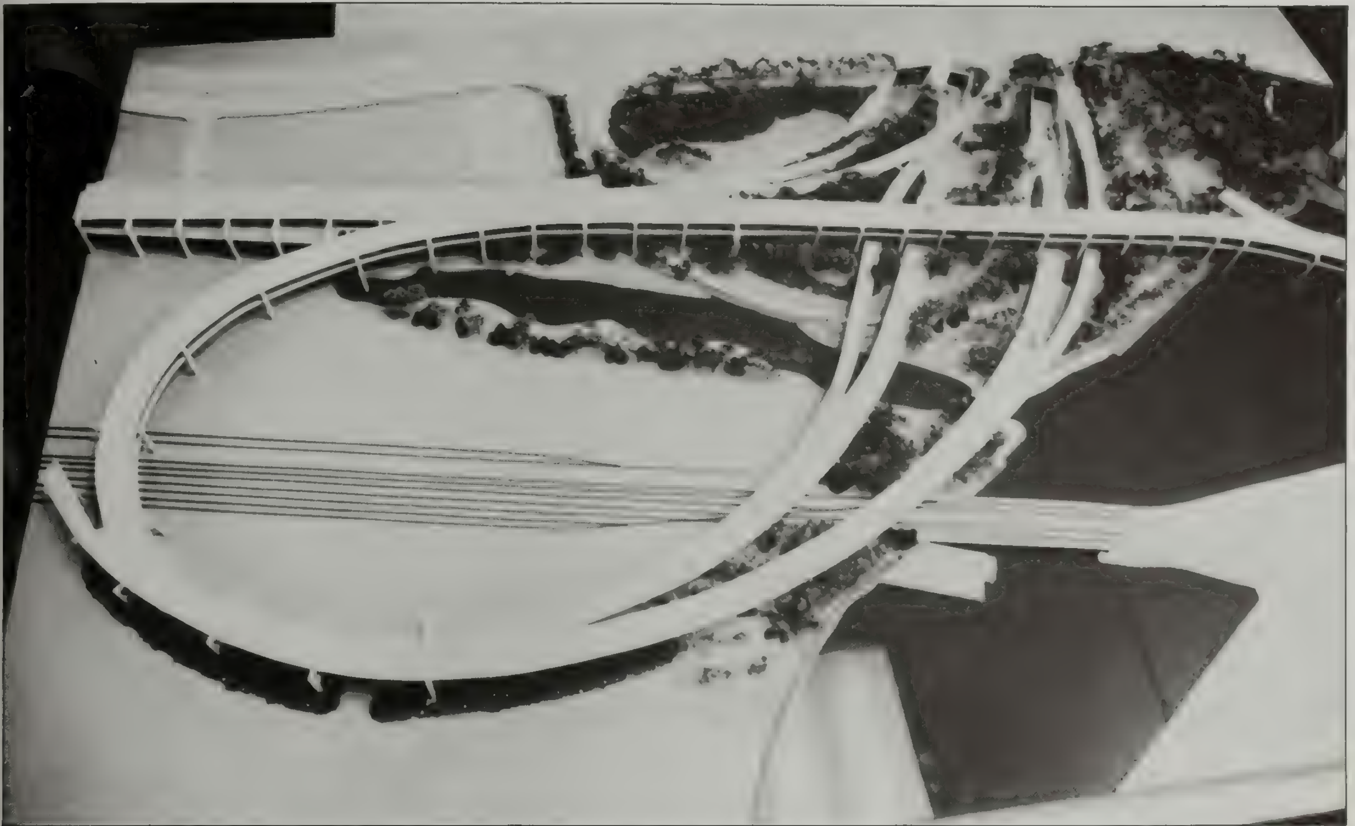
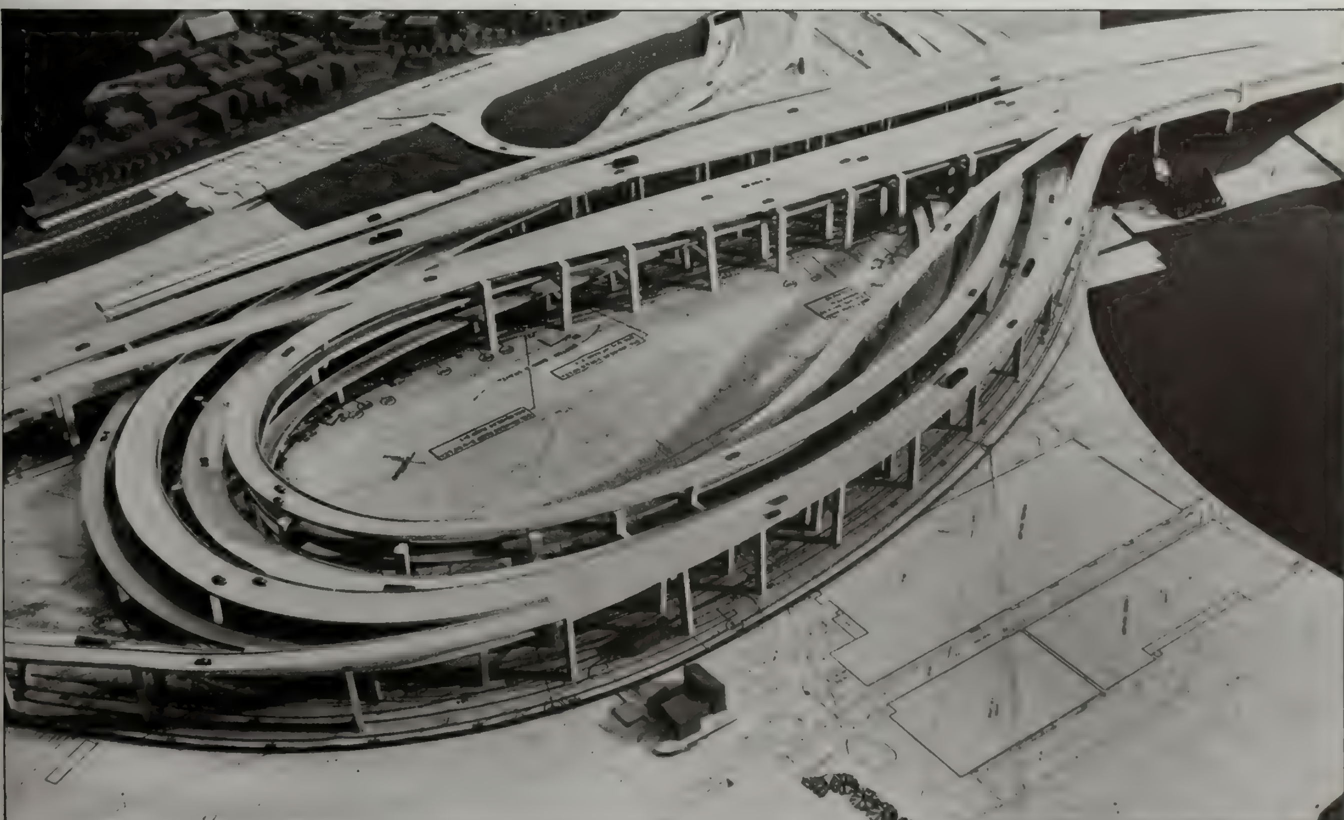


View of CANA Model looking northeast.



View of Proposed Action Model.

FIGURE 9.9

CANA Model And Proposed Action Model

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

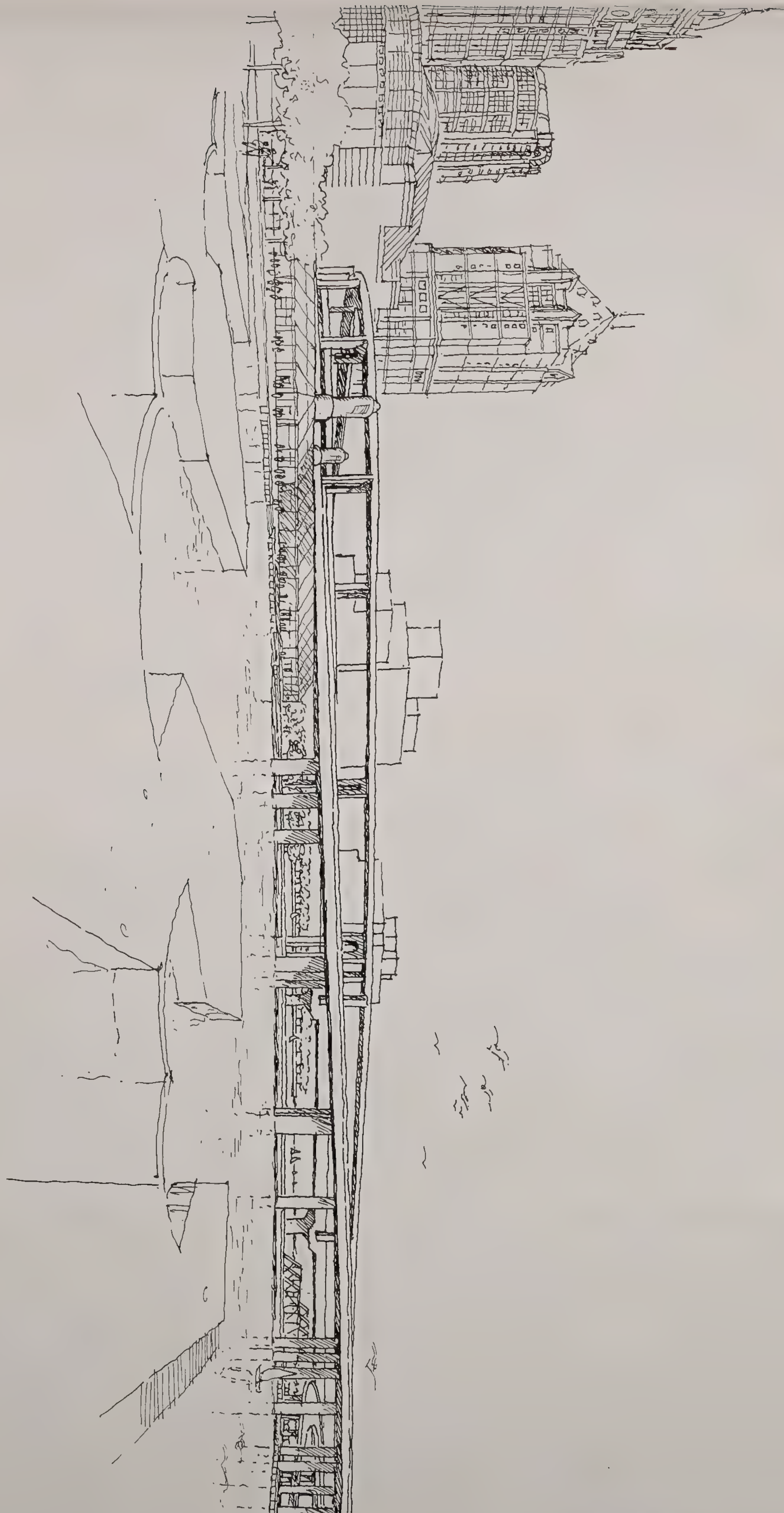
Existing conditions.

View looking north from Causeway Street to new park above I-93 tunnel portal and Charles River bridges. Proposed new Boston Garden development on left.

FIGURE 9.10

North Station – Charles River Pedestrian Connection

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R



View from the Charles River Dam locks looking at both banks of the River under the bridge.

FIGURE

9.11 View Of Charles River Looking West

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

View of boat basin of the Charles River from the Green Line viaduct near Science Park Station.

FIGURE 9.12 View Of Charles River Looking East

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

From each direction, there will be a major new interchange: north of the Charles River in Charlestown/Cambridge; at the point near South Station and Chinatown where the Massachusetts Turnpike, the Southeast Expressway, and the new Seaport Access Road will meet; and at Logan Airport in East Boston.

At each of these gateways, the driver's view will be dominated by some element of the highway system (viaducts, bridges, tunnels, portals, ventilation buildings, or a toll plaza in East Boston) which will define a point of entry into Boston or Cambridge. In each case, new gateway elements will replace existing entrances.

After passing through the gateway, the driver will travel along a constrained channel, usually a tunnel, to a point where the highway system connects via a ramp to the City street system. This transition from highway to City street is an important visual experience, the point of arrival. The three major gateway experiences are described below.

9.2.2(a) I-93 Southbound, Storrow Drive Eastbound, And Route 1 Southbound Into Central Boston

Following construction of the Proposed Action, drivers entering Boston from the north on I-93 and Route 1, and from the west on Storrow Drive, will share an experience totally unlike the current condition. In each instance, the driver will make a transition from a simple linear surface road or viaduct through a complex multilevel, curvilinear elevated interchange, across the Charles River on a low, wide bridge into the Central Artery tunnel portal beneath Causeway Street. In general, the new highway interchange will form a moving threshold through which drivers will pass before crossing the river on a path pointing them sequentially at the North End, North Station, and the Boston skyline (see Figure 9.13). The specific visual and aesthetic experience will differ with the route, as described below.

The experience of the drive south on I-93 is that of a conventional interstate highway until the motorist approaches the elevated interchange where the southbound mainline passes under, over, and beside other elevated roadways, and the driver or passenger senses and sees viaduct structure and moving traffic on all sides. The viaduct structure surrounding I-93 southbound will dominate the driver's view until the vehicle emerges from the interchange onto the new Charles River bridge, from which panoramic views of the North Station area and the Harbor will frame the entrance into downtown Boston. The entrance sequence will be completed when the observer descends beneath ground level, adjacent to the new North Station arena, in an open boat section and through the wide, low portal into the Central Artery tunnel.

The sequence from Storrow Drive to the Central Artery tunnel will be similar, except for the connections between Storrow Drive and the interchange. Motorists will go through a short tunnel under Leverett Circle before rising to cross the river, first northbound on a new double-decked connector to the interchange, and then southbound on the low, wide mainline bridge in a continuous loop. From the top deck of the northbound connector, drivers will pass over the lower bridges and experience panoramic views out over the river basin, the Harbor, and Charlestown before spiralling through the interchange, over the low bridge, and through the portal into the tunnel.

Motorists from Route 1 will not enter the interchange from a bridge or elevated viaduct; they will descend from the Tobin Bridge into a tunnel under City Square, ascend via the loop

ramps of the interchange, pass between ramps on either side, merge with the southbound mainline, and then descend across the river with I-93 traffic and enter the Central Artery tunnel.

Drivers heading northbound on the Central Artery will emerge from the tunnel at Causeway Street and rise on a bridge across the river. From the bridge they will have expansive views of the river, the Harbor, Charlestown, and Cambridge before coming down onto surface streets or into the Route 1 tunnel through City Square.

Each of the entrances will be characterized by a unique sequence of open boat sections, viaducts, and tunnel enclosure, panoramic views of urban landscape, and focused views of highway structure.

9.2.2(b) Massachusetts Turnpike And Southeast Expressway Into Central Boston

As a result of the Proposed Action, motorists entering Boston from the Massachusetts Turnpike will have views of the long facade and prominent stacks of ventilation building 1 straight ahead as they descend into a boat section under the Southeast Expressway. Ventilation building 2 (off to the left within the I-93/I-90 Interchange), together with ventilation building 1, will form an architectural gateway by framing the distant view between two prominent structures. Motorists will continue through the I-93/I-90 Interchange, crossing over two boat sections and moving under a viaduct, to arrive at Kneeland Street and the Wang building. The new interchange elements and the architecture of the two ventilation buildings will dominate the visual experience (see Section 9.2.5, Ventilation Buildings).

Motorists travelling northbound on the Southeast Expressway to either the Central Artery or Seaport Access Road tunnels will have long views of the Boston skyline before beginning to descend at the West Fourth Street bridge into a tunnel portal near Broadway. Drivers' views will be dominated by surrounding viaducts and the portal. Because motorists will enter the tunnel approximately 0.5 mile further south than they do today, their views of the Boston skyline will be terminated sooner than at present.

Drivers entering Boston from the south on the Southeast Expressway Frontage Road will drive under the West Fourth Street bridge and then rise to an intersection with the West Broadway bridge on a viaduct structure. The road will function much like a City street (such as Atlantic Avenue), but will be on a viaduct crossing over the railroad and open boat sections. Motorists' views will focus on ventilation building 2 on the Frontage Road because of its scale and location. Ventilation buildings 1 and 2 will function as an architectural gateway as motorists pass between them to enter Boston (see Figure 9.14).

9.2.2(c) Logan Airport And Route 1A Into Boston

As a result of the Proposed Action, drivers on Route 1A southbound will have the opportunity to choose a new alternate route, which will continue across airport property on a viaduct to the Third Harbor Tunnel toll plaza near the existing Eastern Airlines Reservation Center. Drivers will have a distant view of the top of downtown Boston buildings before entering the tunnel. The viaduct alignment will give the motorist on Route 1A a panoramic view of the airport and its roadway access system; this new viaduct will form the northeastern edge of an expanded East Boston Memorial Stadium Park (see Figure 9.15).

Motorist's view from Charles River Bridge heading south into Downtown Boston. I-93 tunnel portal at Causeway Street, center. Proposed new Boston Garden development at right.

FIGURE 9.13	**Motorists' View From Charles River Bridge**	THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT SUPPLEMENTAL EIS/R

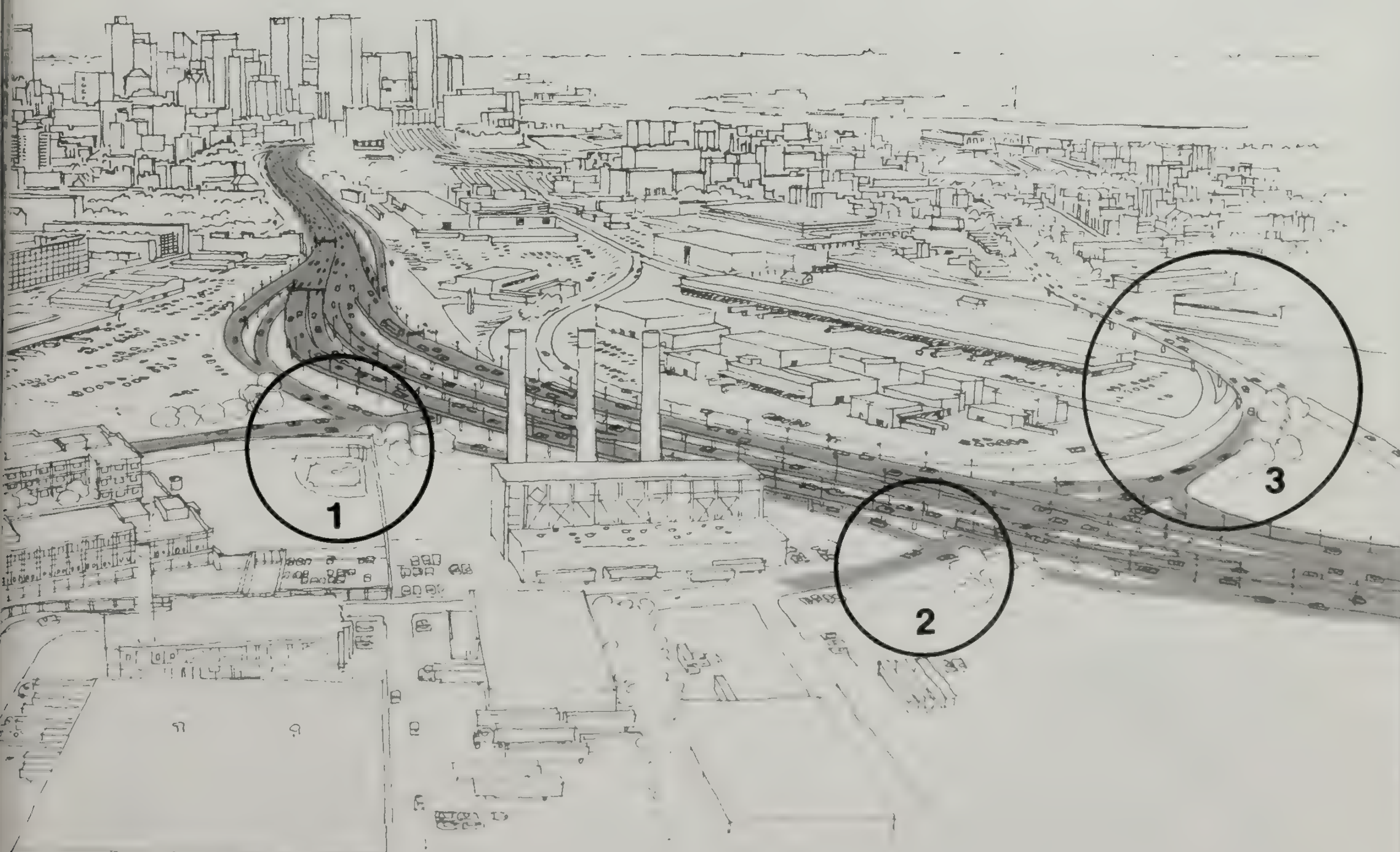
Existing conditions.

Birds-eye view looking north from the new Massachusetts Avenue/I-93 interchange. The redesigned interchange creates residual parcels which can be developed for other uses. The proposed site of the Suffolk County House of Corrections is in the foreground.

1. Elevated connection changed to simpler at-grade connection.

2. Elevated connection changed to simpler at-grade connection.

3. At-grade connection to South Boston Bypass Road.



FIGURE

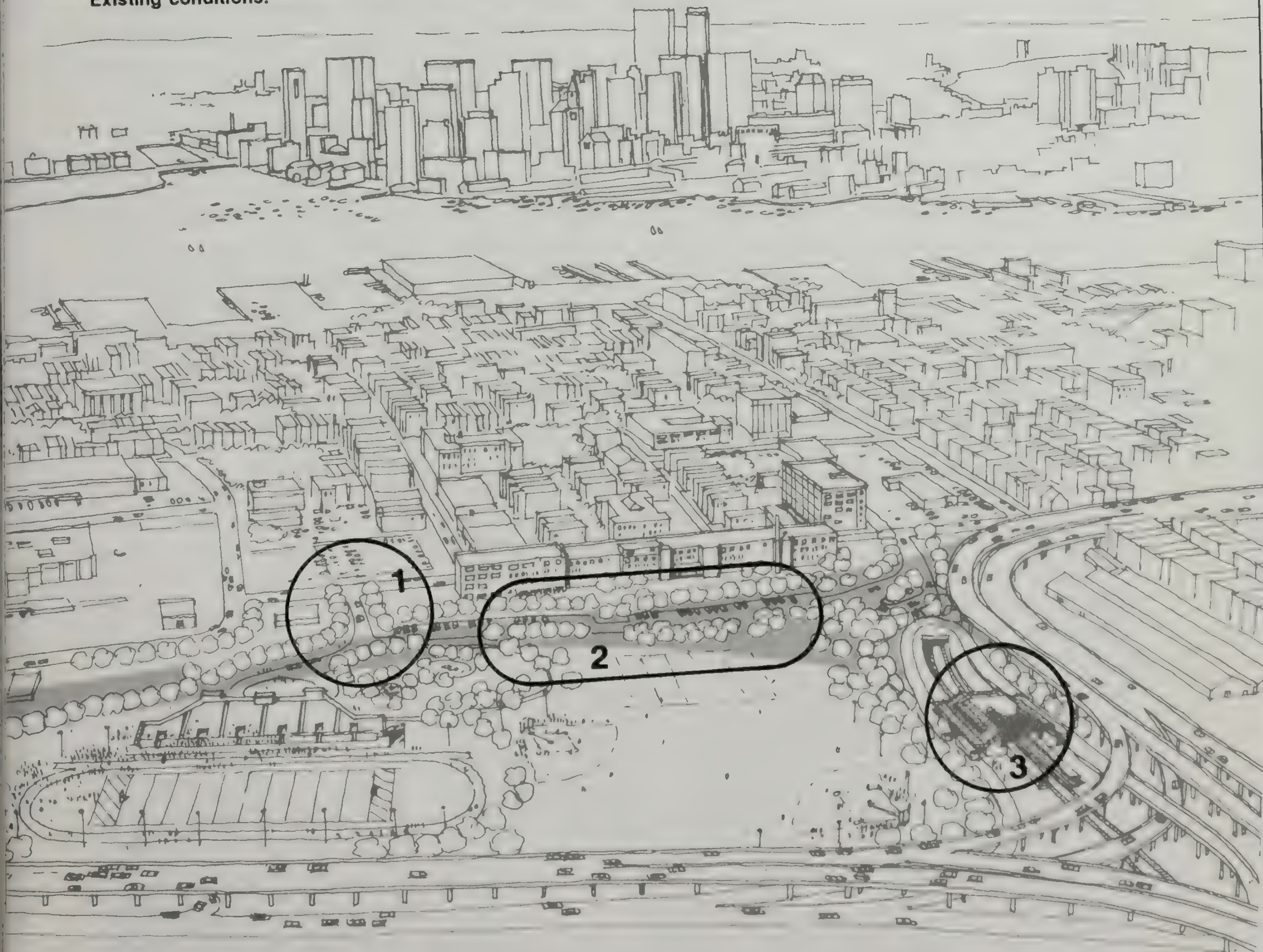
9.14

Massachusetts Avenue And Southeast Expressway Gateway Into Central Boston

Existing conditions.

View of expanded East Boston Memorial Stadium looking back towards downtown. Removal of the airport access ramp has allowed for the expansion.

1. New entrance from community.
2. Reclaimed park area formerly covered by ramps.
3. New MBTA Blue Line Station.



FIGURE

9.15

Aerial View Of Expanded East Boston Memorial Stadium

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Drivers from Logan Airport also may choose the newly extended I-90 westbound to the Third Harbor Tunnel toll plaza. Here their views will be dominated by the toll plaza and, later, the new tunnel.

After passing through the Third Harbor Tunnel (described below) and ascending into South Boston, drivers will either leave the system on a ramp connecting to the proposed B Street extension and Congress Street in the industrial section of South Boston, or continue in another tunnel under Fort Point Channel, and through the I-93/I-90 Interchange, which connects to the Massachusetts Turnpike west as well as to I-93 north and southbound. Drivers exiting in South Boston will arrive in an underdeveloped industrial area dominated by parking lots. If current development proposals are implemented, drivers exiting the tunnel in South Boston will arrive in the middle of a mixed use development on a new street flanked by proposed new buildings framing a view back across the Harbor to East Boston. Those drivers continuing in the tunnel to the Central Area will experience another threshold as they pass through another portal and tunnel (see Figure 9.16), and traverse the I-93/I-90 Interchange before arriving in Chinatown's densely built environment via the ramp connecting to Marginal Road at Harrison Avenue, or continue northbound in the Central Artery tunnel to North Street, on the edge of the North End. The tunnel interior will change from the shape of a cut-and-cover tunnel in South Boston to the more rounded shape of the immersed tube tunnel under Fort Point Channel.

Drivers choosing to use the existing Callahan Tunnel as their route into the City center will either enter the Boston surface street system at New Chardon Street or continue underground in the new Central Artery tunnel.

9.2.3 Tunnels

The tunnel environment described in this section includes the 1.5-mile-long Central Artery tunnel, the 0.9-mile Seaport Access Road tunnel, and the 0.9-mile new Third Harbor Tunnel.

The aesthetic experience for motorists in the three tunnels will be quite different. The Central Artery tunnel will vary in terms of horizontal and vertical geometry and cross section from beginning to end, with ramps exiting and entering the tunnel at uneven intervals. The horizontal alignment will bend in several directions as the tunnel follows the alignment of the existing Central Artery. The vertical alignment, from north to south, will descend from the Charles River crossing and Causeway Street to cross under the Sumner/Callahan Tunnels, ascend to pass over the MBTA Blue Line tunnel at State Street, descend to pass under the MBTA Red Line tunnel at Summer Street, and ascend again to the I-93/I-90 Interchange. The width of the tunnel will vary as a number of on- and off-ramps join and diverge from the through lanes throughout the length of the tunnel. Long, oblique views of walls and traffic will appear as motorists round bends in the tunnel. North- and southbound lanes will be enclosed separately so motorists will not see oncoming traffic.

In general, the motorists' experience in the Central Artery tunnel will be dynamic and diverse as the width and horizontal and vertical alignments vary and on/off-ramps and merging traffic create points at which motorists must make decisions. The ceiling will be a prominent element in relation to the walls, because the tunnel will be wide and low. Motorists in the Central Artery tunnel no longer will have the panoramic views which announce to drivers on the existing elevated Central Artery that they are passing through

the North End, Waterfront, Financial District, and other downtown neighborhoods, thus orienting drivers to their location in the City.

The Seaport Access Road tunnel will be very similar to the Central Artery tunnel with curving geometry but fewer on- and off-ramps except where it passes, in immersed tube, under Fort Point Channel. The lighting and finish material treatment of the high-occupancy vehicle (HOV) lanes will distinguish them from the regular driving lanes to discourage use by other vehicles.

The Third Harbor Tunnel will provide two lanes in each direction, uniform in width for its entire length. The horizontal alignment of the tunnel will follow a gradual but continuous one-directional curve. The profile of the tunnel will descend very gradually from both portals to a low point near the middle at the Harbor bottom. The tunnel will have a definite beginning and ending point for all motorists with no midpoint on- and off-ramps. Motorists will not see the two lanes of opposing traffic. The consistent geometry of the cross section and horizontal alignment and simple geometry of the profile will combine to create an aesthetic experience for the motorist which is relatively unchanging throughout the length of the tunnel. Because of the narrow width and curved horizontal geometry, the curved cross-Harbor tunnel walls will be visually prominent. Motorists will enter and exit the Third Harbor Tunnel from the Seaport Access Road tunnel in South Boston and the toll plaza in East Boston (see Gateways), two major new environments dominated by transportation uses created as a part of the Proposed Action.

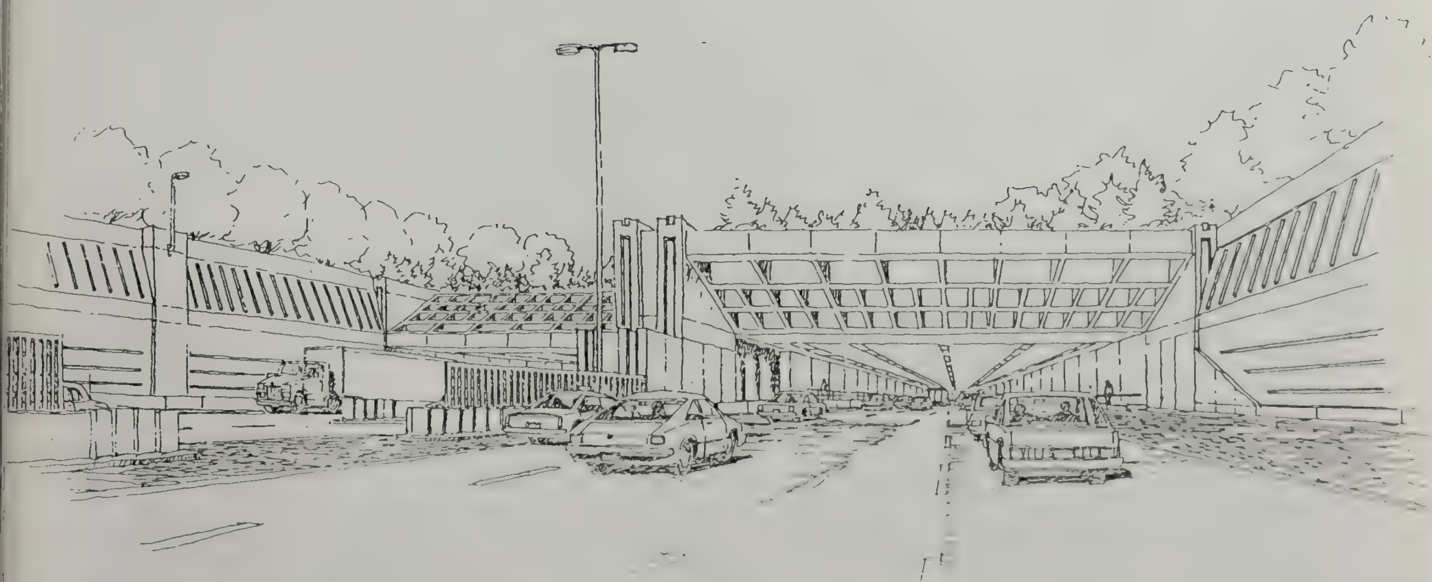
Views for motorists in all three tunnels will be limited to the tunnel's interior architecture, directional signs, and, of course, traffic. The design of the tunnel elements, like the design of any interior public space, will be critical for providing orientation, information, and a safe, visually pleasant experience for motorists. The design of the tiled wall surfaces is being studied to determine how color, textures, graphic symbols, and patterns can be used to mark the driver's location and progress through the tunnel and City, to provide visual cues in anticipation of changing roadway situations, and to reinforce the driver's recognition of emergency and safety features. A variety of tunnel lighting systems, paving materials, and ceiling treatments also are being studied for their contribution to the overall tunnel environment.

The treatment of wall surfaces in the tunnels will focus on the needs for orientation and highway information. The treatments will vary according to the particular conditions of the different tunnels. Caution will be taken to provide adequate information and interest, without distracting motorists' attention. The lighting system will be designed to illuminate the entire tunnel space, rather than just the roadway surface, to increase driver comfort. Route guidance signs will be illuminated and designed to fit into the tunnel's lower clearance height. Variable message signs will alert motorists to changing conditions and special situations. The appropriate design will balance simplicity, interest, information, and safety (see Figures 9.17 and 9.18). (The details of these design features will be completed during final design.)

9.2.4 Central Artery Corridor

The Proposed Action will entail numerous physical changes to streets and pedestrian ways in the Central Area. Because I-93 from Causeway Street to Congress Street will be rebuilt as a

Model of viaduct design details.



Driver-level view of the eastbound tunnel portal in South Boston.

FIGURE 9.16

Viaduct Design And South Boston Tunnel Portal

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Option for Third Harbor Tunnel interior.

Option for Central Artery Tunnel interior.

FIGURE 9.17

Model Of Tunnel Interiors

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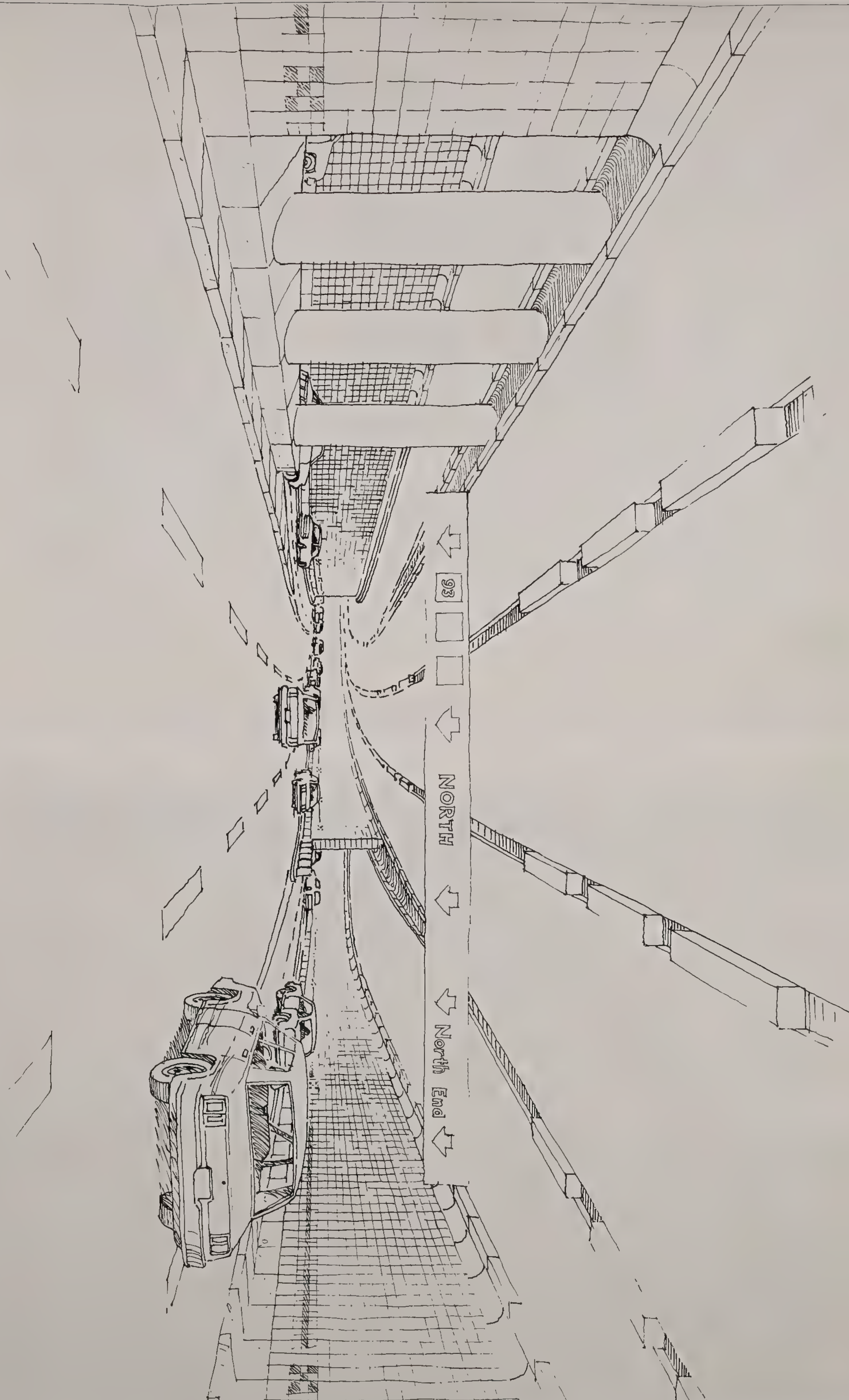
Tunnel interiors have been designed to provide orientation and interest to drivers.



FIGURE

9.18

Tunnel Interiors

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tunnel, following the path of the existing elevated Artery, streets flanking the existing elevated portion of the Artery will be reconstructed. Cross streets (North Washington, Hanover, North, State, and Broad Streets) that now are interrupted by the existing Artery will be reconnected and these, as well as existing cross streets, also will be completely reconstructed where they pass through the project corridor. Areas above the new tunnel between Causeway and Congress Streets will become available for development as buildings and open space.

The following describes the aesthetic impacts of these major changes, the impacts for pedestrians at specific locations, and the visual experience of motorists on the surface arterials.

9.2.4(a) Overall Impacts

Once the new Central Artery tunnel is completed and the present viaduct dismantled, most highway infrastructure will be below grade. The only indications of the highway's presence will be the entrance and exit ramps and directional signs.

Reconstructed streets alongside and crossing the Artery corridor will be of a scale and character appropriate to the surrounding urban areas. They will be provided with an appropriate range of pedestrian amenities -- street trees, special street and pedestrian lights, brick and/or granite sidewalks, benches, and trash receptacles -- reflecting the particular styles and materials of the many neighborhoods and special use districts on both sides of the Artery.

Several important cross streets and pedestrian paths currently interrupted visually by the existing viaduct will be reconnected: North Washington Street, Hanover Street, the Freedom Trail walkway, North Street, Commercial Street, the Walk-to-the-Sea pedestrian walkway, State Street, Broad Street, Pearl Street, and Oliver Street. All lead directly to the waterfront and, when views down these streets no longer are obstructed by the Central Artery viaduct, strong visual links from the Financial District and Government Center to the Harbor will be created. For example, the visual reconnection of State Street will allow a pedestrian to stand in the waterfront area and see the Old State House at the west terminus of the street.

9.2.4(b) Pedestrian Impacts At Four Locations

Because of their importance to the City as pedestrian destinations, visual impacts at four heavily used pedestrian crossings along the Central Artery merit individual discussion: North End/Haymarket, Walk-to-the-Sea/ Christopher Columbus (Waterfront) Park, Rowes Wharf, and Chinatown Gateway.

Upon completion of the Proposed Action, activities in the North End and Haymarket will be linked by sidewalks on a newly reconnected Hanover Street, as well as by a through-block pedestrian way from Hanover Street on the west side of the Artery to Salem Street in the North End (see Figure 9.19). This also will provide a route for the famous Freedom Trail, Boston's most heavily used pedestrian corridor and biggest tourist attraction, linking historic sites. Ventilation building 4 north of Hanover Street between Congress and Blackstone Streets will be designed to house an indoor food market on its ground floor. In addition, a new pedestrian link south from Hanover Street along Cross Street will be made possible by the below-grade direct connection of the Sumner and Callahan Tunnels to the depressed Central Artery.

Following removal of the Central Artery viaduct, a midblock pedestrian way will provide a stronger visual link between the Faneuil Hall/Marketplace area and Waterfront Park.

Both the setting and the approach to Rowes Wharf with its waterfront public spaces and water ferry terminal will be greatly improved as a result of the Proposed Action. In anticipation of removal of the Artery structure, design controls have been established by the BRA for a view corridor from Broad Street to Rowes Wharf. Pedestrians walking east on Broad Street will, therefore, have a direct view of the Rowes Wharf arch and rotunda (see Figure 9.20). Upon reaching Purchase Street, pedestrians on Broad Street will need to make only a slight jog onto High Street, along which they can proceed directly to Rowes Wharf and the waterfront. The Broad Street corridor will thereby physically and visually link the Broad Street historic district to the waterfront.

The Beach Street ramp at Chinatown's east edge will be removed, creating a small parcel which could be developed to form a more visually attractive edge and entrance to Chinatown. The new southbound ramp at Lincoln Street, on the east side of the Surface Artery, will not interfere with pedestrian movements along Beach and Essex Streets between the Leather District and Chinatown (see Figure 9.21).

9.2.4(c) Motorists On Surface Streets

When the new Central Artery tunnel is completed and the existing viaduct removed, motorists will have the choice of two driving experiences: a rapid trip through the tunnel or a slower drive along the reconstructed surface streets flanking the Artery right-of-way.

These continuous streets will provide motorists with an experience unique to the downtown area. Motorists on the north/south surface arterials along the edge of the Central Artery tunnel will experience a nearly continuous ground level route from the south edge of downtown to the north, which is not possible now. The relatively regular arrangement of the surface arterials and cross streets will mean that the blocks created by these streets will be easily accessible and consistent with the local street network. Traffic lights will facilitate pedestrian crossings of these arterial streets at frequent intervals.

Because of the different environments through which the surface arterials will pass, the road's character will vary greatly from one segment to another. Motorists will be aware of several distinct districts and neighborhoods; from north to south they are the Bulfinch Triangle, North End, Broad Street Historic District, Marketplace area, and Financial District. Segments of the surface arterials will be designed and constructed both to harmonize with the adjacent neighborhoods and to provide a visual sense of continuity along the length of the roadway. Some of the various elements used to create a streetscape -- trees, lights, benches, paving, etc. -- will be consistent throughout and others will vary from neighborhood to neighborhood. For example, paving materials, seating, lighting, and landscaping in the North End would reflect the historic and residential character of the area, while in the Financial District, materials would be more appropriate for the area's formality and heavy transient use. The quality will, however, be consistently high, reflecting the importance of the improved pedestrian environment that will be created adjacent to several of Boston's finest urban districts.

A series of specific impressions will characterize drives along the surface arterials. Southbound motorists will move through the Bulfinch Triangle, pass the Government Center

Photo by Peter Vanderwarker ©1989

Photo of Haymarket prior to Artery construction.


Photo by Peter Vanderwarker ©1989

Photo of Haymarket today.

Two views of Blackstone Street looking north toward Boston Garden. Both views show redesigned Haymarket adjacent to depressed Central Artery. This option shows new buildings on the parcel between Blackstone Street and surface artery.

Same view as left photo. This option shows open space on the parcel between Blackstone Street and surface artery.

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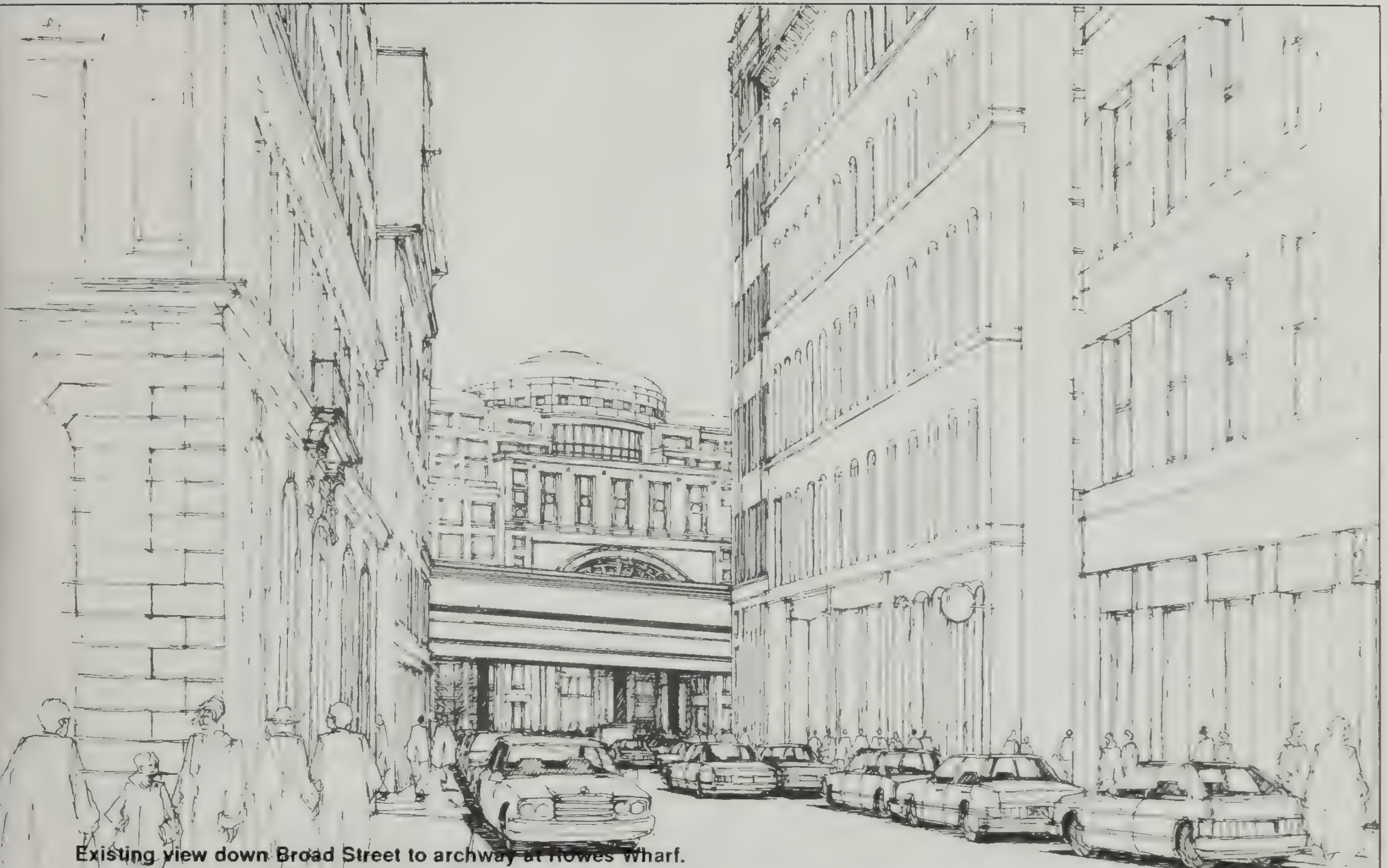
FIGURE 9.19 **Central Area - Haymarket**



Existing view down Broad Street to archway at Rowes Wharf.
The existing elevated Central Artery blocks much of this view.

A dramatic result of the Central Artery depression will be the opening up of this view through the arch.

FIGURE 9.20

Central Area - Broad Street And Rowes Wharf Arch

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With the removal of the Beach Street ramp, and the dedication of the surface artery to southbound traffic, the parcel bounded by Beach and Kingston Streets will be available for other uses. Shown here is one open space alternative; low-scale development would also be possible.

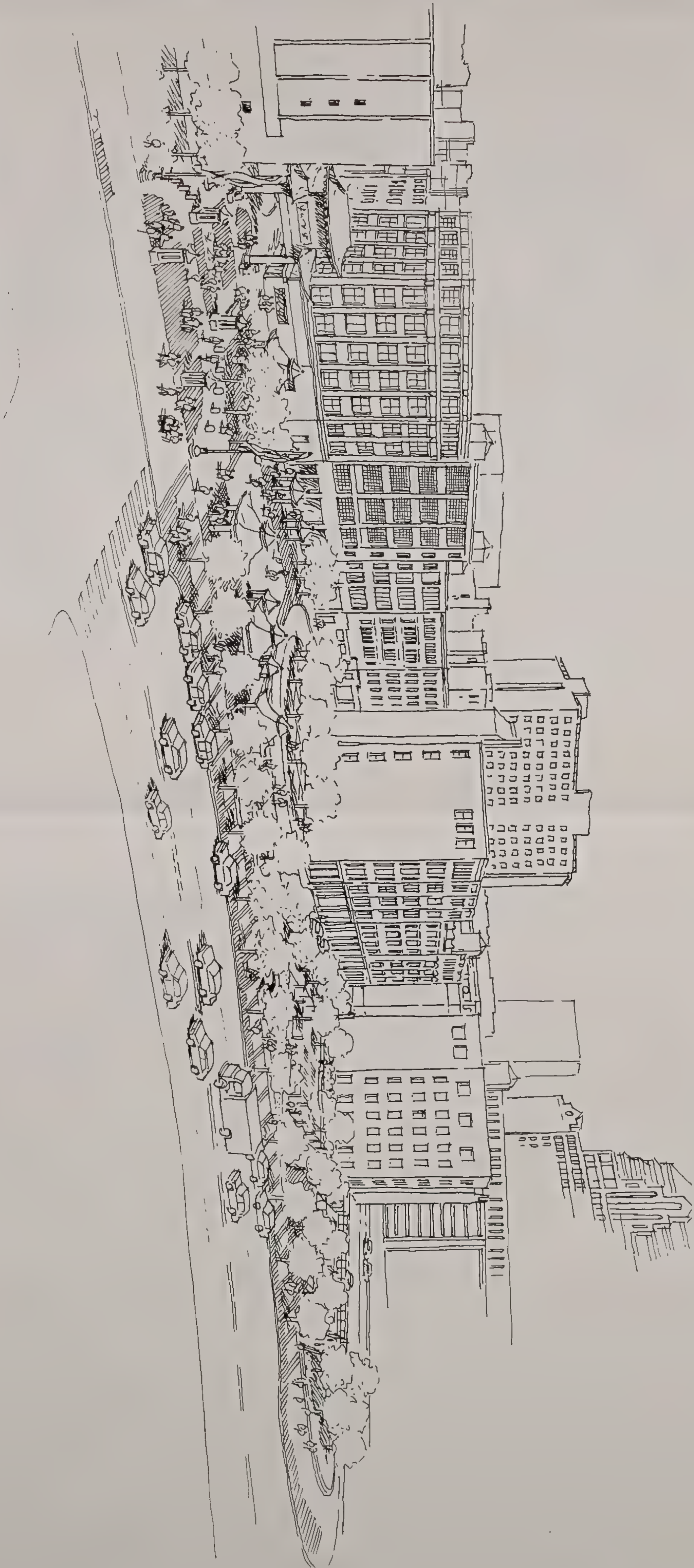

FIGURE 9.21 **Beach Street At Chinatown**

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garage on the west, and see the North End to the east. South of the garage, motorists will confront heavy pedestrian activity generated by the Haymarket. They will also pass ventilation building 4 (see Section 9.2.5, Ventilation Buildings). Further south, motorists will pass another major pedestrian crossing between the Faneuil Hall Marketplace area and Waterfront Park. Here views will expand, with distant vistas of the Harbor and Logan Airport. Ahead, the skyline and the Custom House will be prominent.

After passing State Street, along which motorists will have a direct view of the Old State House to the west, motorists' views will be dominated by Harbor Towers to the east and International Place to the west. Motorists will have uninterrupted views of the Grain Exchange Building and other historic buildings in the Broad Street Historic District, as well as the new Rowes Wharf complex. After International Place, motorists will pass the new ventilation building on the east at the present Boston Edison facility and the new 125 High Street complex on the west, but views will be dominated by the towers of the Federal Reserve Building, the Keystone Building, and One Financial Center at Dewey Square. At the Congress Street intersection, motorists will be able to look along Congress Street to Fort Point Channel. Although similar to existing views, the motorists' views will not be interrupted by the Artery viaduct and ramp abutments.

Views for northbound motorists will be similar to those of southbound motorists in reverse order, but with some notable exceptions. As they pass Congress Street, Russia Wharf, and the new ventilation building, motorists will have a spectacular view as the corridor curves along the Harbor's edge, and as they approach Rowes Wharf they will see the open water beyond. Because the Sumner and Callahan Tunnels will be connected below grade directly to the depressed Central Artery northbound, motorists no longer will encounter heavy traffic entering and leaving the tunnels in the vicinity of the North End. Before they turn onto North Washington Street, motorists will have a distant view of the new Boston Garden complex and, finally, from North Washington Street they will be able to see the U.S.S. Constitution through the intersecting traffic on Causeway Street. In addition, motorists will be aware of pedestrian activity on either side of the road and at intersections.

Development of the new area atop the Central Artery tunnel will strongly reshape these views from the Surface Artery. Because such development is not part of this project, and because the City's new zoning requirements covering this area have yet to be published, it is premature to provide a description of the likely visual impact of the development in this area between the two surface arteries.

9.2.5 Ventilation Buildings

Seven new ventilation buildings will be constructed in visually prominent locations throughout the project area. Each will have a large building volume ranging from 160 by 135 feet to 320 by 80 feet, and several exhaust stacks ranging in height from 80 to 225 feet. (Stack heights are determined by placement and size of adjacent buildings, the height of the roof plane, the amount of air to be discharged from the stack, and air pollution abatement effects. Stack heights as described are maximums, which may be reduced as a result of more detailed analysis during the design process.) Although all the stacks will not be visible from any one vantage point, their number and prominence demand that they receive special architectural treatment. Details of this treatment, currently under study, will be completed during final design. They will become visual reference points for

motorists and pedestrians, as are the existing stacks in South Boston, Dorchester, Dewey Square, and the South End. Similarly, the buildings will be visually significant additions to their urban contexts and will also require special architectural treatment so that they be compatible with and complement the visual environment. Design guidelines will be developed for each building, and where appropriate, will include historic controls. In several cases, uses other than ventilation may be incorporated to fulfill zoning requirements and/or to mitigate the impact of this use on the neighborhood.

Special consideration will be given to the massing, form, and choice of materials for buildings and stacks to be compatible with the surrounding environment. Other design techniques (such as the use of windows, patterns, mixed materials, recesses, landscaping and/or art work to provide texture and interest to large building walls) are also being evaluated.

9.2.5(a) Ventilation Building 1

Building 1 (on Dorchester Avenue) will be approximately 320 feet wide by 80 feet deep and 90 feet high. The stacks will be approximately 130 feet in height (both stack and building heights are measured from grade level). Ventilation building 1 will be designed to be compatible with the visual character of historic Fort Point Channel (see Figure 9.22).

9.2.5(b) Ventilation Building 2

This building (on Frontage Road) will be approximately 160 feet wide by 135 feet deep and 80 feet high. The stacks will be approximately 120 feet in height. Ventilation buildings 1 and 2 will function as landmark elements for motorists entering Boston from the Southeast Expressway and the Massachusetts Turnpike. The possibility of joint development of first floor commercial space is being explored for ventilation building 2. Building 2 will be designed to be compatible with the future development of parcels created in the new interchange. Because of the proximity of the two ventilation buildings to each other, attention will be given to the relationship of the two sets of stacks in terms of shape, materials, and arrangement (see Figure 9.22).

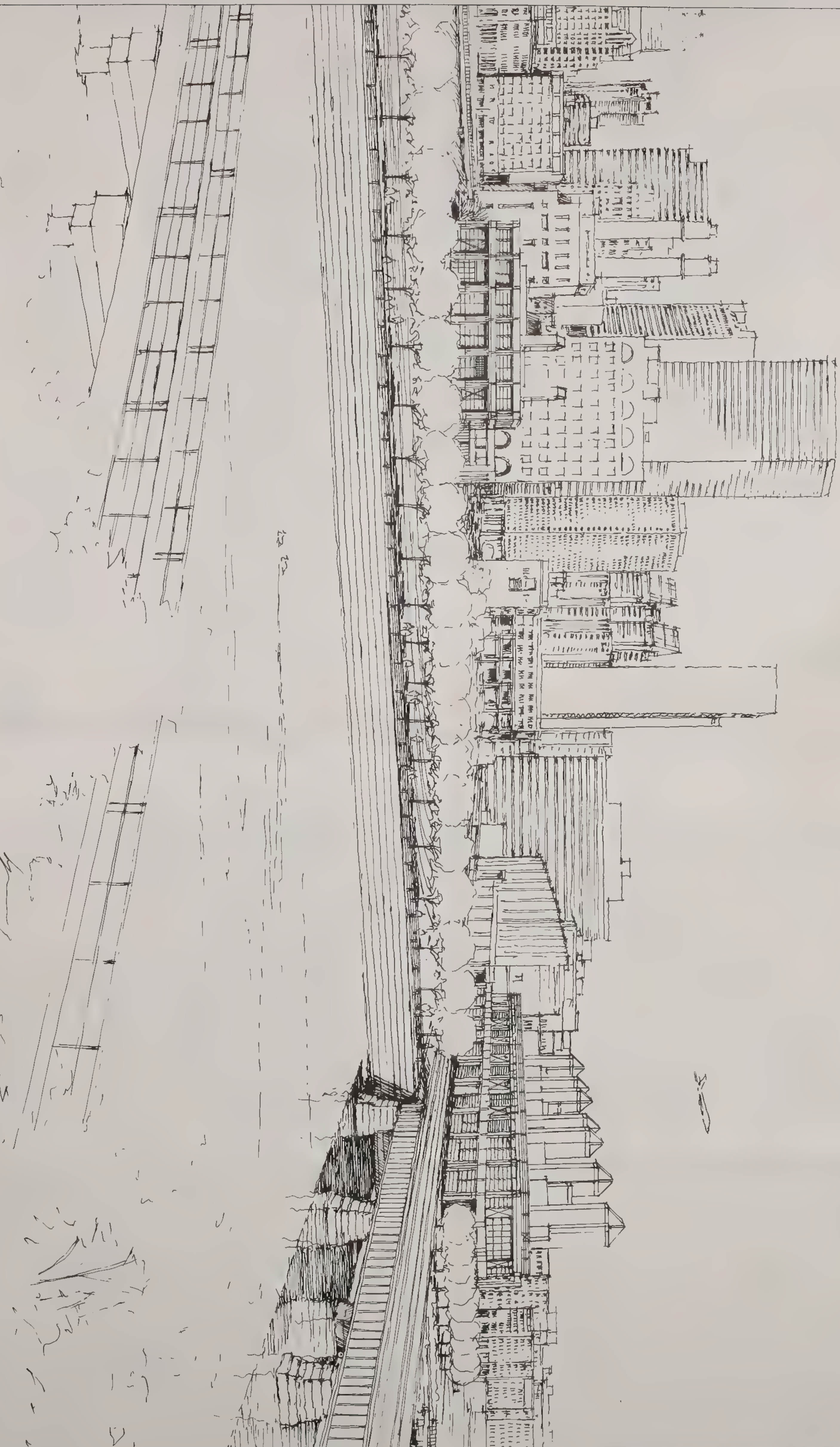
9.2.5(c) Ventilation Building 3

Building 3 (on Atlantic Avenue) will be built on the existing Boston Edison transformer site between Atlantic Avenue and Fort Point Channel. All the ventilation functions will be located below grade except for the 240-foot-high exhaust stacks. The stacks, however, can be shielded from view at the pedestrian level by constructing a building around them (see Joint Development Appendix). The building will be designed to accommodate the Pearl Street pedestrian movement and view corridor to Fort Point Channel (created by the Proposed Action), although views of the Channel from 125 High Street will be partially blocked. The design will be compatible with nearby historic buildings and districts. The incorporation of retail frontage along Atlantic Avenue will enhance the pedestrian environment. Special architectural treatment of the stacks can make them a positive addition to the area. The new structure will screen the existing Boston Edison substation from motorists' and pedestrians' view on Atlantic Avenue, which will have a positive visual impact in this area (see Figure 9.23).

9.2.5(d) Ventilation Building 4

Of the seven ventilation buildings, the design for ventilation building 4 (adjacent to the Blackstone Block) is in the most advanced stage of development. It will cover the entire

View of Ventilation Buildings 1 and 2 facing north from the Broadway Bridge. Fort Point Channel in foreground and South Station railroad tracks at right.



FIGURE

9.22 **Vent Buildings 1 And 2**

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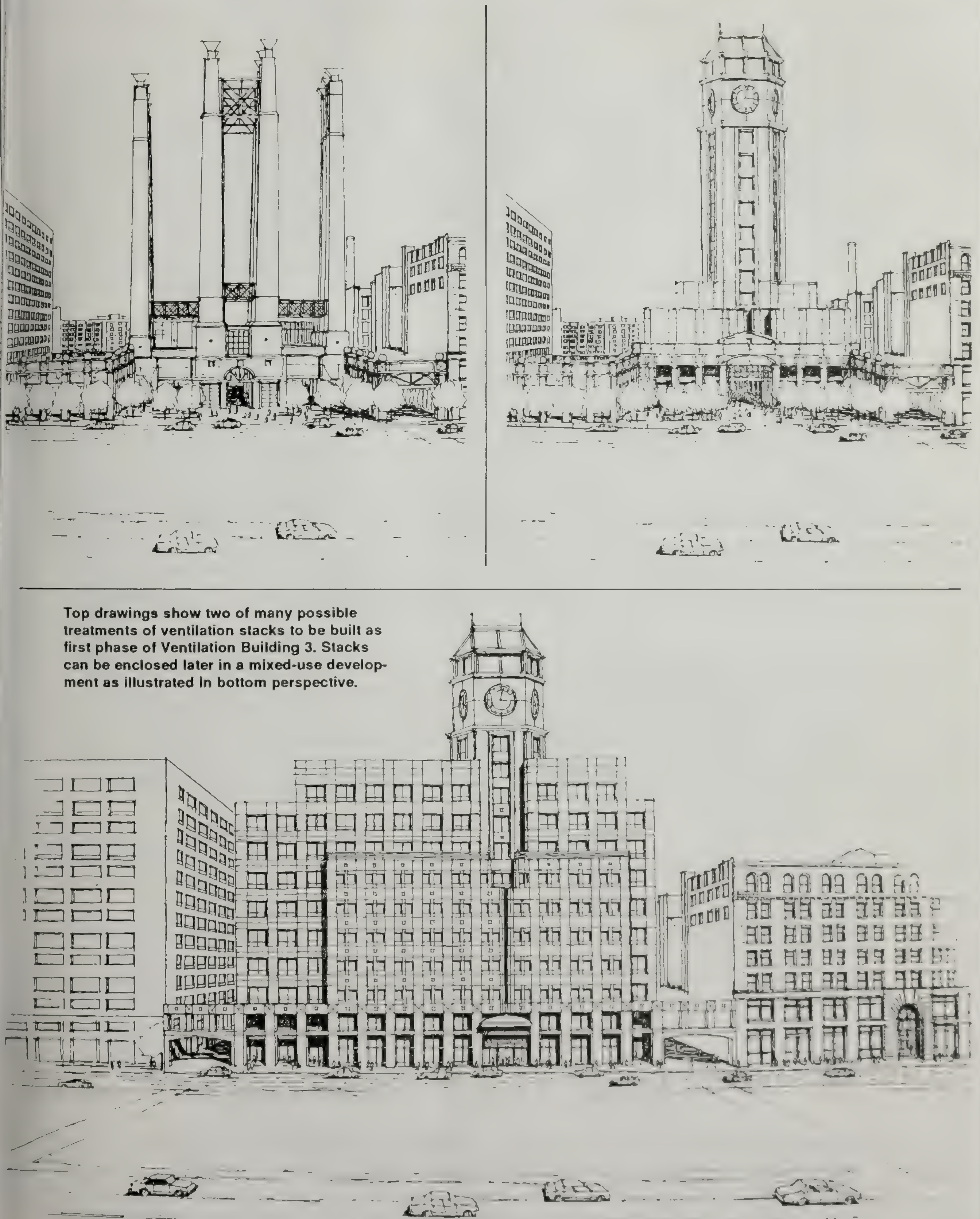

Top drawings show two of many possible treatments of ventilation stacks to be built as first phase of Ventilation Building 3. Stacks can be enclosed later in a mixed-use development as illustrated in bottom perspective.

FIGURE 9.23

Vent Building 3 – Boston Edison Site, Atlantic Avenue

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parcel to a height of approximately 80 feet with 125-foot stacks. In addition to the ventilation equipment and stacks, this building is planned to contain a replacement parking garage for spaces displaced by the Artery/Tunnel Project; replacement Haymarket pushcart storage; food-related market activity similar to North End businesses; improvement to the MBTA Orange/Green Lines Haymarket station entrance; and general purpose office space. The design of the building will be compatible with the adjacent historic Blackstone Block and help to visually and functionally expand the North End character across the Central Artery to Congress Street (see Figure 8.15 and the Joint Development Appendix). Design guidelines for this building will include both historic guidelines and BRA urban design guidelines.

9.2.5(e) Ventilation Building 5

This building will consist of two structures, one for air intake, one for exhaust. The intake facilities (adjacent to Summer Street near the intersection of Congress and B Streets) will be approximately 210 feet wide by 150 feet deep. The exhaust stacks, approximately 120 feet in height, will be located to the west between Congress and Summer Streets. Most of the exhaust fans will be below grade; at grade, the parcel will be developable as a park, consistent with City plans. The intake building will be designed to blend into the existing commercial and historic character of Summer Street and Congress Street. Its base will respect the scale and character of the adjacent handsome 19th century buildings. The development of first floor commercial space to create an active street frontage is planned to be consistent with the proposed BRA design guidelines. The exhaust stacks will be designed to be visually interesting elements in the surrounding landscape.

9.2.5(f) Ventilation Building 6

Building 6 (at the Subaru Terminal) will be approximately 200 feet wide by 130 feet deep and 75 feet high. A backup Operations Control Center also will be included in the structure. The stacks will be approximately 115 feet high. The building, which will serve as a landmark structure from both the ground and the Harbor, will be designed to reflect the character of the neighboring industrial buildings on Massport-owned land and the Boston Marine Industrial Park (see Figure 9.24).

9.2.5(g) Ventilation Building 7

Building 7 (on Bird Island Flats) has been located to minimize impacts to development proposed for the area by Massport and private developers. The building will be approximately 310 feet long by 100 feet wide and 65 feet high, with 95-foot-high stacks. An existing substation, dislocated by the tunnel alignment, will be replaced by a new one immediately adjacent to this ventilation building. The design will be consistent with Massport's Bird Island Flats design guidelines. The stacks, which will be visible from the Jeffries Point neighborhood in East Boston, will provide an opportunity to create a visually interesting element on the airport's skyline (see Figure 9.24).

9.3 MITIGATION MEASURES

The City of Boston traditionally has attempted to maintain high architectural and aesthetic standards for physical developments to be compatible with its many historic districts and to achieve high quality in new construction. Therefore, the design for the Proposed Action will visually complement the existing and planned architectural environment around it, going beyond simply providing sound and efficient transportation facilities. These standards will

be met throughout the project area in the form of architectural design and details, including but not being limited to the shape of fascias and guardrails on viaducts; the location and design of support piers and open boat section walls; the materials, lighting, and landscaping of roadways; and special features such as signs and pedestrian rails, paving, and lighting. The use of high-quality design details for all elements of the project will be implemented through design standards now being developed for inclusion in final design contracts. Through the consensus developed in the ongoing design and public participation processes, high standards for the design of the visual environment will be provided.

In some situations, special measures will be required to mitigate specific negative impacts. Some of the elements being evaluated currently as possible mitigation include the following:

9.3.1 Charles River Bridges

- o Specific mitigation measures to reduce the project's visual impact of the bridge piers in the Millers and Charles Rivers and on their riverbanks are recommended in the Section 4(f) Evaluation in Part III of the SEIS/R. The structural design, placement of columns, lighting, and architectural treatment of perimeter facade, underside, and columns will be done so as to be as compatible as possible with the proposed park improvements, and to present an acceptable appearance to abutting uses in the North Point area of Cambridge and the Charlestown area bordering the ramps.

- o Lighting under the bridges as a way to mitigate shadow impacts is being studied, as is increased frequency and/or width of openings between deck spans, and special architectural treatments of the under-deck surfaces.

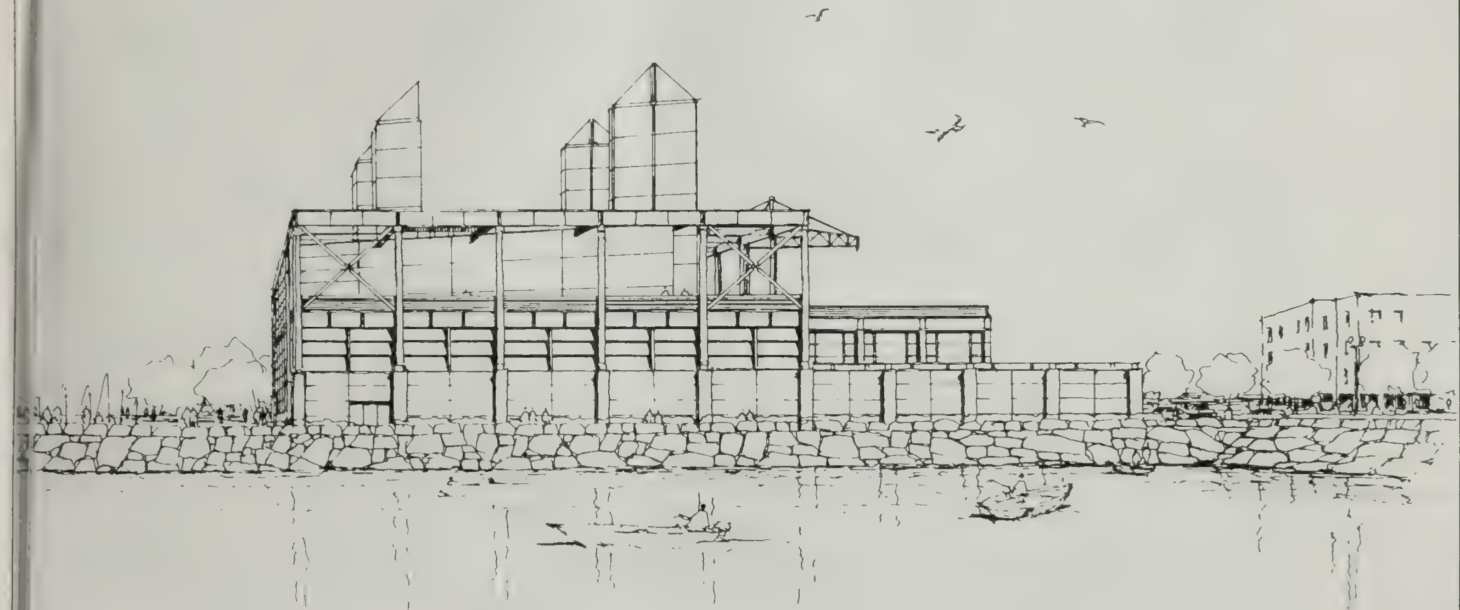
- o The design of the bridges, to serve as a handsome landmark structure, is being studied, as a means of rendering the bridges a positive addition to the cityscape.

- o Development of new parks at Causeway Street and on Lovejoy Wharf will mitigate pedestrian access, acoustical and shadow impacts on the south bank of the Charles River.

9.3.2 Gateways

- o Alternative Charles River bridge design features are being considered, including haunched girder and cable-stayed bridge structures. Bridge design is a major factor in the overall aesthetics of the area surrounding the Lower Charles River, which the FEIS/R identified as a potential measure to mitigate visual impacts on Section 4(f) properties. The Proposed Action currently assumes that the Charles River crossing will be on three closely spaced bridges with 17 supporting columns. The haunched girder bridge type permits a more aesthetic bridge design using a complex of four bridges on eight columns. The cable-stayed bridge also would have four spans and eight supports, two of which would be major towers. This bridge type is the most visually impressive and potentially beautiful concept, and it would create a major landmark gateway to the City, but would be substantially more costly than other structural schemes.

View of Ventilation Building 6 facing southeast from adjacent General Ship drydock. The exposed structural system is designed to fit in with the surrounding industrial character. Public access is provided around the water's edge.



View of Ventilation Building 7 facing northeast from Bird Island Flats at Logan Airport.

FIGURE 9.24

Vent Building 6 (South Boston) And Vent Building 7 (East Boston)

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The above alternate bridge types would widen sight lines across and along the river at ground level and would present more aesthetically pleasing forms, which would continue to be dominant visual elements. Both engineering and aesthetic analyses are needed, together with agency coordination and public discussion, in order to determine the technical and cost feasibility and desirability of alternate bridge types.

- Portals and boat sections will be designed with generous rights-of-way wherever possible to eliminate the need for pedestrian security fencing. Where such fencing is required in visually prominent locations, its design will feature special architectural treatment.

9.3.3 Tunnels

- An effort will be made during the design phase to develop visual symbols representing distinctive features of the surface environment within the Central Artery tunnel as a means of orienting the motorist regarding location.

- Tunnel and ramp portals will be designed to be attractive architectural elements in the cityscape, for both highway users and pedestrians, and others who view the highway.

9.3.4 Central Artery Corridor

- Removal of the visually unattractive elevated Central Artery structure is the primary visual mitigation measure in the project right-of-way between Causeway Street and High Street. Surface redevelopment will be consistent with design objectives to be developed through the joint development process (see Joint Development Appendix).

9.3.5 Ventilation Buildings

- Alternative architectural building treatments and joint development opportunities are being developed and analyzed relative to specific buildings.

- Stacks will be designed as sculptural elements of the urban landscape which symbolize the project in a positive manner. Their prominence will be strengthened or lessened, depending upon the setting, by refining their heights, arrangement, and special architectural treatments. Participation in a project arts program is also a likely action.

9.3.6 Projectwide

- Special treatment will be given to major architectural elements (viaducts, ramps, tunnels) and secondary elements (rails, signs, etc.). This treatment may involve participation in a project public arts program.

- Undesirable views will be screened by means of architectural and landscape architectural devices.

- o Impacts to the pedestrian environment will be mitigated by the creation of pedestrian paths, bridges, and other landscape or architectural amenities and open space features. A public arts program may be used to enhance these features.

9.4 COMPARISON WITH FEIS/R

9.4.1 Charles River Bridges

- o The new bridges have been moved to the west of the existing bridge and away from Charlestown's City Square. (The Preferred Alternative in the FEIS/R flanked both sides of the existing bridge.) The new bridges will be wider and lower and the addition of the Leverett Circle connector will result in a larger, higher, denser, and more visually complex interchange, closer to the river edge and to Cambridge's North Point area, than was the case with the Preferred Alternative in the FEIS/R but will allow for greater expansion of Paul Revere Landing Park.

- o The Leverett Circle connector behind the new arena will eliminate the tunnels and depressed roadways to be located along the south riverbank as proposed in the FEIS/R. This will greatly improve conditions for the MDC's planned eastward extension of the Esplanade on the south bank.

9.4.2 Gateways

- o North of the Charles River, the changes are those described above within Section 9.4.1, Charles River Bridges.

- o In East Boston, the airport access road has been relocated to the northeast side of East Boston Memorial Stadium Park, allowing for expansion of this park to the south and reconnection to the Porter Street neighborhood. In addition, the removal of the viaduct from the west side of the park near the MBTA Airport station, also proposed to be renovated, will enhance the visual environment at the park's west entrance. The I-90 proposed toll plaza has been placed in Logan Airport, rather than in South Boston.

- o The I-93/I-90 Interchange will be larger and more visually complex, both at and above grade, than that described in the FEIS/R.

9.4.3 Tunnels

- o Although the alignment has shifted in some areas, the tunnels have not changed substantially from conditions described in the FEIS/R.

9.4.4 Central Artery Corridor

- o The impacts in this area are substantially the same as those described in the FEIS/R.

- o The realignment of roadways around Chinatown will create several new development parcels which can be used to expand and visually enhance the edges of Chinatown.

9.4.5 Ventilation Buildings

- o Ventilation buildings proposed in the FEIS/R have been removed from the North End, the Charles River bank, Harbor Towers, and in front of 470 Atlantic Avenue, eliminating the future visual impacts these buildings would have caused.

- o The two ventilation buildings (1 and 2) in the I-93/I-90 Interchange area will be more visible than the conditions described in the FEIS/R. The FEIS/R alternative included only one ventilation building in the interchange, and it was in a less prominent location. Ventilation building 1 will be visible to motorists approaching the Central Area from the south, east, and west.

- o Ventilation building 3 has been relocated from its placement over the tunnel near Northern Avenue as proposed in the FEIS/R, to the Boston Edison substation parcel on Atlantic Avenue. The building's new location will help to screen views of the substation from Atlantic Avenue.

- o Ventilation building 4 is being designed to be a positive new addition to the North End/Government Center area. In the FEIS/R, this ventilation building was to be located adjacent to the North End at Clinton Street, with limited opportunity for joint development.

- o Ventilation building 5 in South Boston is being designed as two buildings due to a realignment of the highway. Their design will accommodate the City's development plans. In order to allow for the public open space use designated for this area by the BRA, most exhaust fans will be placed below grade and carefully insulated to mitigate their otherwise possible adverse impact on the City's plans.

- o The location of ventilation building 6 in South Boston has been shifted from the south to the north side of Fid Kennedy Avenue on the Subaru parcel at BMIP. This relocation will not have a major effect on the visual impact of the building.

- o Ventilation building 7 on Bird Island Flats has been relocated further north than proposed in the FEIS/R to minimize visual impacts on future Bird Island Flats development.

9.5 RESOLUTION OF ISSUES RAISED BY PUBLIC AGENCIES

A more detailed description of the impacts of the Charles River crossing was requested by the Department of Environmental Protection, the Metropolitan District Commission, the Cities of Cambridge and Boston, and the Charles River Watershed Association. The text was expanded to comply with these requests.

More information on visual impacts on the City of Cambridge was requested by the Cities of Cambridge and Boston and the Metropolitan Area Planning Council. The text was expanded to comply with these requests. (Also see the alternatives analyses and the Section 4(f) Evaluation for the Area North of Causeway Street in Parts II and III, respectively, of the SEIS/R.)